GOVERNMENT OF TAMIL NADU
TRUTH ALONE TRIUMPHS

District Wise Survey of Agro Forestry Tree Species Utilized and Grown in Order of Demand in Tamil Nadu

April 2006 – March 2007

FOREST UTILISATION OFFICE
CHENNAI

Forest Utilisation Division
Research Wing
Tamil Nadu Forest Department
Chennai

DISTRICT WISE SURVEY OF AGROFORESTRY TREE SPECIES UTILIZED AND GROWN IN ORDER OF DEMAND IN TAMIL NADU

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Junior Research Fellow

1.0. INTRODUCTION

The strides of human evolution have been through forests. Man learnt the art of domesticating plants and animals after leaving his hunting and gathering habit. Man's desire to live in co-existence in a community led to settled agriculture. Acceleration in human and livestock population necessitated acquisition of more and more land under cultivation that continued to meet the ever increasing demand for food, fodder, vegetables, fuel wood, timber, medicines etc. Further, demographic pressure has forced man to seek unconventional methods of agriculture to utilize land to the maximum extent. The National Forest Policy (1988) has set a goal that 33% of the country's geographical area should be under forest and tree cover. Under the Tenth Five Year Plan, the Government of India has set a target to increase the country's forest cover up to 25%. According to the latest report of the Forest Survey of India (2001), the forest cover in the country is 675,538 km², constituting 20.55% of its total geographical area. Out of this, dense forest constitutes 12.68 % and open forest 7.87 %. The forest cover in the hills districts is only 38.34 % as against the desired 66% area.

The only solution to achieve these targets is through the practice of agroforestry. Therefore in the quest of optimizing productivity, the multi-tier system came into existence. The origin of agroforestry practices, i.e. growing trees with food crops and grasses, is believed to have begun during the Vedic era (Ancient period, 1000 B.C.), Agroforestry as a science was however introduced only recently.

Agroforestry is the science of designing and developing integrated, self-sustainable, land-management systems that involve the introduction and retention of woody components such as trees, shrubs, bamboos, canes and palms along with agricultural crops including pastures or animals, simultaneously or sequentially on the same unit of land and time, to satisfy the ecological as well as socio-economic needs of people. Agroforestry, the word coined about two decades ago, has made its place in all the developed and the developing countries of the world. The practice of introducing trees in any form to the farming world has played a significant role in enhancing productivity on per unit area basis.

The pressure on the agricultural lands has increased manifold due to the increasing population, expansion of urban area and the industrialization process. With this not only the agricultural production has been affected but the environment has also been disturbed. People are facing new kinds of diseases, wildlife is vanishing and the soil is loosing its productivity. Farming community is trying all means to increase land's productivity. Chemical fertilizers and water are applied in higher proportion, causing pollution hazards. Under all these circumstances agroforestry has shown that beside sustainable agriculture it can also help promote a better environment.

1.1.AGROFORESTRY CONCEPT

Agroforestry has the capability to increase the productivity and at the same time maintain the nutrient balance. It also protects the nature. Due to its technical and economic potential, it can sustain agricultural production. It has two major roles to play; the productive role and the service role. Appropriate definition of agroforestry can be that "it is a collective name for land-use system and technologies in which woody perennials, trees, shrubs, bamboo etc. are deliberately combined on the same land management unit with herbaceous crops and animals in some form of spatial arrangement of temporal sequence" Tree has the dominant role to play in all agroforestry systems for sustainable agriculture and environmental protection. Tree planting reduces salinity, improves soil fertility, controls and prevents erosion, controls waterlogging, reduces catchment eutrophication and possibly checks acidification, increases local biodiversity and reduces the green-house effect.

1.2.DEFINITIONS OF AGROFORESTRY

Various definitions of agroforestry have been compiled, while conceding that no definition is really comprehensive, exact and undisputed strictly scientific definition of agroforestry should stress two characteristics common to all agro-forestry practices, and should be separated from all other forms of land- use. These characteristics are as follows:

1. The deliberate growth of woody perennials on the same unit of land along with agricultural crops and animals either in some form of spatial mixture and in some temporal sequence.

2. There must be significant interaction: ecological and other components of the practice.

While promoting agroforestry, the aims, potential and positive interaction ecological or economic – can be emphasized only when proved scientifically.

Increased production and productivity, sustainable land management and conservation are some of the important aims of agroforestry.

Some of the important definitions of agroforestry are given below

- Agroforestry is a sustainable management system for land that increases overall production, combines agricultural crops, tree crops and forest plants and or animals simultaneously or sequentially and applies management practices that are compatible with the cultural patterns of the local population (Bane et al., 1977).

- Agroforestry is sustainable land-management system, which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants or animals simultaneously or sequentially on the same unit of land and applies management practices that are compatible with the cultural patterns of local population (King and Chandler, 1978).

- Agroforestry is a land-use that involves deliberate retention, introduction, or mixture of trees or other woody perennials in crop animal production field to benefit from the resultant ecological and economical interactions (Nair, 1984).

- Agroforestry is a collective name for land-use systems and technologies in which woody perennials including trees, shrubs, bamboos etc. are deliberately combined on the same land-management unit with herbaceous crops or animals either in some form of spatial arrangement or temporal sequence. In agroforestry system there are both ecological and economic interactions amongst the different components (Lundgren and Raintree, 1982).

In simple terms agroforestry can be defined as "an efficient land-use system where trees or shrubs are grown with arable crops, seeking positive interactions in enhancing the productivity on a sustainable basis".

1.3. NEED AND SCOPE OF AGROFORESTRY

Agroforestry, in true sense, has been realized as a need of the day. It does not confine to the regional, geographical or agro-climatic boundaries. Agroforestry concept is an universal application.

Agro-forestry for Food, Fuel and Fodder Needs

Owing to the increase in population of human and cattle, there is increasing demand of food as well as fodder, particularly in developing countries like India. Each year the farmers of the world must attempt to feed 81 million more people irrespective of weather conditions. It is important to note that there will be 19% decline in crop land per head by the end of this century due to population explosion. In general, there is acute shortage of food and fodder in developing countries. However, the situation in

India is more alarming than in other countries of the Third World. Asia possesses the smallest area of the "potentially arable land" '(672 million ha compared with 681 million ha in South America and 734 million ha in Africa)' and has the highest population. Out of this, 590 million ha (83%) is already under cultivation. Therefore there is slight scope to increase food production by increasing the area under cultivation. Hence food production is to be increased from the land already under cultivation or from land not conventionally considered arable. A management system therefore needs to be devised that is capable of producing food from marginal agricultural land and is also capable of maintaining and improving the quality of producing environment. In India too a similar situation with regards to food, fodder, fuel and fiber exists. There is a global crisis of energy and man is striving hard to find out same alternative source of energy. We may have sufficient food but not the fuel to cook. Fuel wood is one of the established sources to meet energy requirement. At present we are utilizing 60-80 million tons of dry cow dung, equivalent to 300-400 million tons of freshly collected manure. Agroforestry has both productive and protective potential, and it can play an important role in enhancing the productivity of our lands to meet the demand of ever-growing human and livestock population. The different aspects in which agroforestry can help are given in the subsequent paragraphs.

Food

- Enhanced sustainability of cropping systems through soil and water conservation by arrangements of trees to control run-off and erosion.
- Enhanced food and feed production from crops associated with trees through nitrogen fixation, better access to soil nutrients brought to the surface from deep tree roots, improved availability of nutrients due to high cat-ion exchange capacity of the soil and its organic matter and mycorrhizal associations.

- Food for man from trees in the form of fruits, nuts, cereal substitutes etc.
- Feed for livestock from trees.
- Micro-climate improvement due to trees, particularly shelter-belts and wind-breaks.

Water

- Improvement of soil-moisture retention in rainfed croplands and pastures through improved soil structure and micro-climate effect of trees.
- Regulation of stream flow, reducing flood hazards and a more even supply of water through reduction of run-off and improvement of interception and storage in infiltration galleries.
- Improvement in drainage from waterlogged or saline soils by trees with high water requirements.

Energy

- Fuel-wood for direct combustion.
- Pyrolytic conversion products such as charcoal, oil and gas.
- Ethanol produced from fermentation of high-carbohydrate fruits.
- Oils, latex and other combustible saps and resins.

Shelter

- Building materials for shelter construction.
- Shade trees for people, livestock and shade-loving crops.
- Wind-breaks and shelter-belts for protection of settlements, crop lands, pastures and roadway.

- Fencing: live fences and fence posts.

Raw Material for Industries

- Raw material for pulp and paper industry.
- Tannins, essential oils and medicinal ingredients.
- Wood for agricultural implements and various crafts.
- Fibers for weaving.

Cash

- Direct cash benefits from sale of tree products.
- Indirect cash benefits from increased productivity.

1.4. HISTORICAL BACKGROUND

Broadly the development of agroforestry in India can be studied under four categories

Agroforestry during the Vedic Era

Man was basically a food collector during the Vedic era. Man gradually acquired the knowledge of plant species yielding food, fruits, vegetables etc. The origin of agroforestry practice, i.e. growing trees with food crops and grasses, believed to have happened during the Vedic or Pre-Vedic period in India. The Rishis, Munis and Gurus were residing in forests, where they derived food in the form of vegetables, dry fruits, sweetening medium, medicine and gum, besides fuel. Further, they developed Ashrams and started growing fruit trees for their needs. Man gradually developed settled farming with the passage of time. However, there were many more who moved with receding forests, entirely depending on forest for food and shelter. They came to be known as forest-dwellers, who cleared some forest area and started growing agricultural crops without any input such as fertilizer and irrigation. They cultivated agricultural crops for 3-5 years thereafter the practice kept on rotation. This practice was called shifting cultivation which was prevalent in Madhya Pradesh, Orissa, Andhra Pradesh, Bihar, North- Eastern states and the Andaman, Nicobar group of islands.

Agroforestry during the Epic Era

The period of Indian history during which the two great epics (*Ramayana* and *Mahabharata*) were composed is known as the Epic Era. *Ramayana* was composed by great poet Maharishi Valmiki. In this epic he illustrated that Rishis and Munis were growing mango, banana, guava, sweet potato, barley and flowers. They mostly utilized the foodgrains, fruits and vegetables grown on the Ashram land. Maharishi Valmiki had nicely illustrated the arrangement of trees: ashok, neem, papal and bargad in outer ring; jackfruit, mango and banana and guava in middle ring; and flowers such as *champa, chameli, juhi, bela* etc. in inner ring, keeping *sarove* (water-tank) in the centre in Ashok Vatika. This clearly indicated that trees, fruit trees and flower plants grown in association in the *vatika* (garden) were the development of an agro-forestry practice. *Mahabharata* was composed by Maharishi Ved Vyas. The agro-forestry practices were improved during this period compared with those in *Ramayana* period. The great teacher Dronacharya not only raised trees, fruit trees and vegetables, but also raised sanwa and barley in the orchard, which were used for food and God's worship. Rearing of silkworm and lac-worm was a popular profession during that period. It is evident from *Ramayan*a and *Mahabharata* that agroforestry practices such as agri-silviculture and agri-horticulture were in operation in their primitive state during the Epic Era.

Agroforestry during Medieval Period

Agriculture was in its primitive state during the medieval period. However, many agroforestry practices existed. Examples include planting trees for shade and shelter, boundary demarcation by planting trees, multipurpose trees, nitrogen fixing trees, timber trees and the trees yielding fruits, nuts, food, fuel and fodder. Flower and fruits of *mahua*, bamboo seeds and others were consumed by people. Toddy was also produced from trees such as palms and *mahua*. The tribal dances performed around these trees are symbolic of the intimate ethnic bias to protect trees. Trees had considerable social, ethnic and religious backing.

Agroforestry during the Recent Past

In the recent times, especially during the last 3-5 centuries, spectacular improvements were made in tree plantation. The most important agro-forestry practice is known from the Kangeyam tract of Tamil Nadu, where *Acacia leucocephala* + *Cenchrus setigerus* in silvipasture system was perfected. Similarly, in ravines of Yamuna and Chambal, trees, shrubs and bamboos with grasses were planted for rearing the milk-producing Jamunapari breed of goats and sheep. Scattered trees with *khejri* or *mehndi* in association with *bajra, jowar* and chillies were grown in the semi-arid area of Tamil Nadu. Tree plantation continued as demarcation and control against wind erosion throughout the country. Plantation of *khejri* trees for various uses on farm was a common practice in Rajasthan.

In the coastal areas, *Casuarina equisetifolia* and other trees were grown in association with crops on farm lands for cash and to generate small timber. Live hedges were common as an agroforestry practice in which *Mehndi*, *Agave sisilana* and *Euphorbia* species were common. In paddy-sowing areas, *Pongamia glabra* and *Sesbania grandiflora* were grown, lopped annually and their leaves applied to fields as green manure. Application of green manure to paddy field was common also in Madhya Pradesh and Uttar Pradesh. In Western Ghats *Terminalia* leaves were harvested, spread on land, burnt and then paddy, *ragi* and millets were sown. Multi-storey homesteads or home gardens were in existence in Kerala, Karnataka and Tamil Nadu as an important agroforestry practice. This practice is still followed in these states to fulfill the needs of fodder, fuel-wood, fruits, vegetables, medicines etc.

1.5. CLASSIFICATION OF AGROFORESTRY SYSTEMS

Agro-forestry systems can be classified on the basis of structure, function and socio-economic aspects.

Structural Classification of Agroforestry Systems

The structure of the agroforestry system can be defined in terms of its components and the expected role or function of each. In this system the type of components and their arrangement are important. Hence on the basis of structure, agro-forestry systems can be grouped in two categories:

- Nature of components and
- Arrangement of components

Nature of Components

On the basis of nature of components the following are common agroforestry systems prevailing in different agroecological regions of India:

- Agri-silviculture (trees+crops)
- Boundary plantation (tree on boundary + crops)
- Block plantation (block of tree+ block of crops)

- Energy plantation (trees+crops during initial years)
- Alley cropping (hedges+crops)
- Agri-horticulture (fruit trees+crops)
- Agri-silvi-horticulture (trees+fruit trees+crops)
- Agri-silvipasture (trees+crops+pasture or animals)
- Silvi-olericulture (tree + vegetables)
- Horti-pasture (fruit trees+pasture or animals)
- Horti-olericulture (fruit tree + vegetables)
- Silvi-pasture (trees+pasture/animals)
- Forage forestry (forage trees+pasture)
- Shelter-belts (trees+crops)
- Wind-breaks (trees+crops)
- Live fence (shrubs and under- trees on boundary)
- Silvi or Horti-sericulture (trees or fruit trees+sericulture)
- Horti-apiculture (fruit trees + honeybee)
- Aqua-forestry (trees + fishes)
- Homestead (multiple combinations of trees, fruit trees, vegetable etc).

Besides these common agroforestry systems, there are many more component combinations followed in different agro-ecological regions of India.

Arrangement of Components

The arrangement of components gives first priority to the plants. Even in agroforestry system involving animals, their management according to a definite plan, e.g. a rotational grazing scheme, gives precedence to the plants and animals. Such plant arrangements in multi-species combinations involve the dimension of space and time.

Spatial Arrangement

Spatial arrangement of plants in an agro-forestry mixture may result in dense stands(as in home-gardens) or in sparce mixed stands (as in most systems of trees in pasture). The species (or species mixture) may be laid out in zones or strips of varying widths. There may be several forms of such zones, varying from microzonal arrangements (such as alternating rows) to macrozonal ones. A common example of the zonal pattern is hedge-row intercropping (alley cropping), and an extreme form is the boundary planting of trees on edges of plots and fields for a variety of purposes (fruit, fodder, fuel-wood, fencing, soil conservation or wind-break etc.). The extreme forms of macrozonal arrangements can lead to sole- cropping systems, but the interactive association of different components can be used as criteria to decide the limits between zonal agro-forestry and sole crop (component) plots.

Temporal Arrangement

Temporal arrangement of the plants in agro-forestry may also take various forms. An extreme example is the conventional shifting cultivation cycle, involving 2-4 years of cropping and more than 15 years of fallow cycle, when a selected woody species or a mixture of species may be planted. Similarly, some silvi-pastural systems may involve grass leys in rotation with some species of grass remaining on the land for several years. These temporal arrangements of components in agro-forestry are termed coincident, concomitant, overlapping (relay cropping), separate and interpolated.

1.6. FUNTIONAL CLASSIFICATION OF AGROFORESTRY SYSTEMS

Two fundamental attributes of all agroforestry systems are productivity and sustainability.

Productive Functions

The various productive functions (producing one or more products) of agroforestry systems are food, fodder, fuel-wood and other woods, besides other products.

Protective Functions

The protective functions (protecting and maintaining production systems) of agroforestry systems are wind-break, shelter-belt, soil conservation, moisture conservation, soil improvement and shade (for crops, animals and man).

1.7. SOCIO-ECONOMIC CLASSIFICATION OF AGROFORESTRY SYSTEMS

Based on such socio-economic criteria as scale of production and level of technology input and management, agroforestry systems are grouped into three categories.

Commercial System

The term commercial is used whenever the scale of the production of the output (usually a single commodity) is the major aim of the system: the scale of operations is often moderate to large and ownership may be government, corporate or private; labour is normally paid or otherwise contracted. Examples include commercial production of agricultural plantation crops, other crops or pasture animals; with permanent underplanting of food crops, or pasture/animals; commercial production of shade-tolerating plantation crops such as coffee, tea and cocoa under overstorey shade trees; rotational timber or food crops system in which a short phase of food-crop production is used as a silvi-cultural method to ensure establishment of timber species (various forms of *taungya*) ; commercial grazing and ranching under large-scale timber and pulp plantations etc.

Intermediate Agroforestry System

Intermediate agroforestry systems are those between commercial and subsistence scales of production and management, production of perennial cash crops undertaken or medium to small scale, wherein the cash crops cater for cash needs, and the land or long term tenancy rights to land reside and work themselves on the land, supplemented by paid temporary labor. Various agroforestry systems in many parts of the world can be considered intermediate systems, especially those based on plantation crops such as coffee, cocoa numerous fruit trees and short-rotation timber species.

Subsistence Agroforestry System

Subsistence agroforestry systems are those wherein the use of land is directed towards satisfying the basic needs, and is managed mostly by the owner or occupant and his family. Cash crops including sale of surplus production of commodities, and all forms of traditional shifting cultivation are the most widespread examples.

1.8. TRADITIONAL AGROFORESTRY PRACTICES IN INDIA

Shifting Cultivation

In this system the natural vegetation, usually forests, is cleared by slash- and-burn method, cropped with common arable crops for a few years, and then left unattended till the natural vegetation regenerates. Traditionally the fallow period was 10-20 years but recently it is reduced to even 4-5 years. Due to the increasing demographic pressure, the fallow is became greatly reduced and the system degenerated, resulting in heavy soil erosion and decline in fertility and productivity of the soils. Within the general patterns of alternating fallow and cropping cycles, the nature of shifting cultivation differs from place to place. The important common feature of the shifting cultivation is growing of mixed crops after partial or complete removal of vegetation. In north-eastern India, many annual and perennial crops with diverse growth habits are being grown, having sparsely distributed trees on hilly lands. At times cash crops such as potato, rice, maize and ginger are grown in monoculture or mixed culture along with *Pinus kesiya.* Another important attribute of the system is secondary succession of vegetation during the fallow period. Various patterns have been identified in north-eastern India.

After the cropping phase of the system, while burning the slash, carbon, nitrogen and sulphur are lost due to volatilization. After the burn and before the onset of the first rains, a sizeable quantity of nutrients is lost through blown-off ash due to strong winds during dry seasons. The sediment loss during the cropping period was reported to be 30ton/ha/year in a *jhum* cycle of 5 years, and with the shortening of the cycle the losses tended to be higher. The evolutionary pattern of shifting cultivation revealed that sustainability and higher productivity can be achieved only when conservation and restoration measures are introduced before the severe depletion of natural resources.

Increase in population and shrinking land area per family have forced them, as well as the researchers concerned about their plight, to look for land management systems by which they can get something from the land even during the so-called fallow phase. Thus intercropping under or between fast-growing trees in a fallow phase has emerged as one of the alternatives to shifting cultivation. A farming-system approach based on watershed management has also been advocated as an alternative to shifting cultivation.

Taungya Cultivation

Taungya system is practised in Kerala, West Bengal, Uttar Pradesh and to a limited extent in Tamil Nadu, Andhra Pradesh, Orissa, Karnataka, as well as in the north-east hills region. It is practised in areas with an annual rainfall of 1,200-1,500 mm. The practice consists of land preparation, tree planting, growing agricultural crops for 1-3 years, and then moving on to repeat the cycle in a different area. In some cases crops may be grown 1 year before the trees are planted. A large variety of crops and trees, depending upon the soil and climatic conditions, are grown under the system. The owner of the land, and hence the trees, is the State Forest Department. Establishment of teak (*Tectona grandis*) plantations is the most remunerative taungya practice for Forest Departments.

Due to the prevailing land shortages, and the possibility of growing highly remunerative crops like paddy, tapioca, ginger and turmeric, the farmers in Kerala are willing to pay to lease forest land for taungya. In the high hills of Tamil Nadu, *Eucalyptus globulus*, *Acacia mearnsi* and *Pinus* species are established after growing a crop of potatoes. More recently, cashew plantation in the coastal area of Andhra Pradesh has been established in combination with groundnut. It is also possible to grow two crops of groundnut in a year. In the agreement between the farmer and land-owner, it is mentioned that groundnut leaves cannot be removed from the land due to their value in soil conservation and fertility improvement. Since 1960s, large commercial farmers have used taungya for the establishment of poplar plantation with irrigation in the sub-montane, sub-humid Terai region of Uttar Pradesh.

Home Gardens

Home gardens show a transition stage between tropical forest ecosystem and arable cropping, which mutually support sustainable agriculture and forest ecosystems. It also preserves the biodiversity.

Tropical home gardens consist of an assemblage of plants, which may include trees, shrubs, vines and herbaceous plants growing in or adjacent to a homestead or home compound. These are intended primarily for household consumption and there is intimate association of woody perennials with annual and perennial crops and invariably livestock, within the compounds of individual houses, with the whole crop-tree-animal unit being managed by family labour. Plantation crops such as coconut, cacao, coffee, arecanut and black pepper (vine) often are the dominant components of many home gardens of the humid tropics.

Banana, papaya, mango, guava, custard apple and jackfruit are the common fruit and vegetable plants. In spite of very small average size of the management units, home gardens are characterized by high species diversity and usually 3-4 vertical canopy strata. The important aspect of these gardens is that the production for home consumption occurs throughout the year. These gardens have well-developed irrigation and drainage systems. On canal banks *Cocos nucifera, Colocasia esculenta* and *Alocasia odora* are planted. *Sesbania grandiflora* is planted as fence, green manure and fuel wood. Some gardens may have flowers particularly *Rosa indica, Poyianthes tuberosa, Dahlia pinnata* and *Gladiolus gandavensis*. In recent years much of the forested and bare lands are allocated to farmers, where they grow trees along with their crops. Very well-designed farming systems and their components have been adopted by the farmers to improve the land capability.

Large Cardamom Plantations of Eastern Himalayas

Cultivation of cardamom plantations under *Alnus nepalensis* differs from the earlier practice of its collection from the natural forests by indigenous Lepcha and Limbu tribes is an age-old agroforestry practice in eastern Himalayas. Besides *Alnus nepalensis* (which is a prevalent tree), there are 29 other tree species supporting the plantation crop. Farmer's tree management practices involve harvesting trees above 16 cm basal diameter to assist natural regeneration of younger tree seedlings and open canopy to regulate light at the ground. This tree-management system provides continuous supply of fodder and fuel-wood. The nitrogen-fixing trees help site improvement and better growth of cardamom. The tree management helps cardamom production also. With other fodder trees, lopping during November after maturation of cardamom and not allowing twigs to fall on it does not interfere with the production and makes it an economically viable system.

Alder-based Agriculture in North -Eastern India

Alder *(Alnus nepalensis*) is grown in Nagaland to enhance soil fertility for growing maize, millets, potato, chilies, barley, pumpkin etc. Tribal people have exploited the nitrogen-fixing capacity of alder to retain soil fertility. It is the main component of coffee and cardamom at lower and higher altitudes as a shade tree. At 6-8 years of its growth the tree is pollarded at a height of 2-2.5 m, its leaves and twigs are heaped on the ground and burnt, and the ashes are spread to enrich the soil.

Plantation based Cropping Systems

Modern commercial plantation crops like rubber, coffee and oil palm represent a well managed and profitable stable land-use activity in the tropics. The scope for integrative practices involving plant associations in these commercial plantations is limited, except during the early phases of plantation when some intercropping is feasible, the commercial production of these crops is aimed at having a single commodity. Some of the plantation crops like coconut palm have been cultivated since very early times, but their economic yield remained low.

However, research and commercial yields of these crops have increased substantially. Contrary to popular belief, a substantial proportion of tropical plantation crops are grown by small-holders. For example, most of the cacao production in Ghana and Nigeria comes from small holdings. It is grown with specific crops like maize, cassava, banana, cucumber and sweet potato, especially during the first 4 years of planting cacao. Most of the coconut production in India, the Philippines, Sri Lanka and the Pacific Islands comes from small holdings, in which coconut palm is integrated with a large number of annual and perennial crops like clove, cardamom, coffee, cacao, cassava, yams, fodder grasses and legumes. Grazing under coconut and cashewnut is also common. In India, Tanzania, Mozambique and Senegal, small holders grow cashew trees (in wider space) with other crops.

Coffee is integrated with other crops including banana, maize etc. in Ethiopian highlands, Colombia and Kenya. Coconut is one of the most widely-grown tree crops in the tropics, found mostly on islands, peninsulas and along coasts, covering an area of 6 million ha. In the last two decades most of the data have come from coconut-based systems in India, related to intercropping under coconuts, integrated mixed farming in small holdings, grazing under coconuts, factors favoring intensification of land use with coconuts and multi storey tree gardens.

Important cereals grown with coconut include rice, finger millet and maize, pulses such as pigeon pea, green gram and black gram, cowpea soyabean and groundnut; root crops such as sweet potato, yams, cowpea, elephant foot-yam and taro; spices and condiments such as ginger turmeric, cinnamon, clove, chilies, and black pepper; fruits like pineapple, mango, banana, papaya and bread fruit; and cash crops such as cotton, sugarcane, sesame; condiments such as arecanut, cacao and coffee, among improved pasture grasses species of *Brachiaria, Dichanthium, Panicum, Setaria, Paspalum* and *Pennisetum* and improved forage legumes such as *Stylosanthes, Desmodium, Glycine, Leucaena* and *Macroptilium*. Many trees such as species of *Erythrina, Ceiba* and *Cordia* find a place in the system.

Scattered Trees on Farm Lands

The practice of growing agricultural crops under scattered trees on farm lands is quite old and does not seem to have changed for centuries. Though the world-wide list of such trees is long, some of them have received more attention than others, e.g, *Prosopis cineraria* in north-western India and *Faidherbia albida* on West Africa. The species diversity in these systems is very much related to ecological conditions. With the increase in rainfall, the species diversity and system complexity increases. Thus there is a proliferation of more diverse multi storeyed home gardens in the humid areas and less diverse, two tiered canopy of configurations (trees+crop) in drier areas.

Trees are grown scattered in agricultural fields for many uses such as shade, fodder, fuel wood, fruit, vegetables and medicinal uses. Some of the practices are very extensive and highly developed in India. For example, growing of *Prosopis cineraria* and *Zizyphus* in arid areas; *Acacia nilotica* in Indo- Gangetic plains; *Grewia optiva* and other tree species in the Himachal Pradesh; *Eucalyptus globulus* in the southern hills of Tamil Nadu and *Borassus flabellifer* in peninsular coastal regions. There are strong convictions for the acceptance of these trees on agricultural fields since time immemorial. Farmers retain trees of *Acacia nilotica, A. catechu, Butea monosperma., Dalbergia sissoo, Mangifera indica, Zizyphus mauritiana* and *Gmelina arborea* in Gujarat with crops. Farmers in subhumid *terai* region of U.P. prefer *Dalbergia sissoo, Syzyzium cuminii* and *Trewia nudiflora*. In Bihar *Dalbergia sissoo, Litchi chinensis* and *Mangifera indica* are frequently grown on fields. Farmers in north-eastern region prefer *Alnus nepalensis, Artocarpus chaplasha,* species of *Bambusa, Dendrocalamus,* and fruits like *Mangifera indica* and *Parkia roxburghii*. In coastal areas of peninsular India *Borassus flabellifer* is found scattered in the fields of groundnut, rice and greengram.

Every part of the Borassus palm is used by common man: the leaves for thatching, trunk as pillar or timber, fruit is roasted and consumed the radicle of germinating seeds is roasted; a beverage (Toddy) is extracted from the spadix, which is also used to prepare jaggery and vinegar. Other most common trees found on farmer's fields are *Azadirachta indica, Moringa oleifera, Tamarindus indica, Ceiba pentandra, Anacardium occidentale, Cocos nucifera* and fruits like banana, custard apple, guava and pomegranate.

Trees on Farm Boundaries

Trees grown in agricultural fields or on field bunds are also often and usually grown on farm boundaries. In northern parts of India, particularly in Haryana and Punjab, *Eucalyptus* and *Populus* are commonly grown along field boundaries or bunds of paddy fields; other trees which are found grown as boundary plantations or live hedge include *Acacia nilotica, Dalbergia sissoo* and *Prosopis juliflora.* Farmers of Sikkim grow bamboo *(Dendrocalamus*) all along irrigation channels. In coastal areas of Andhra Pradesh *Borassus* is the most frequent palm. In Andamans, farmers grow *Gliricidia sepium*, *Jatropha* spp. *Ficus, Ceiba pentandra, Vitex trifoliata* and *Erythrina indica* as live hedges. At many places succulents like *Agave* and many cactoids are grown as common live fence. Many of the boundary plantations also help as shelter-belts and wind-breaks, particularly in fruit orchards. In Bihar *Dalbergia sissoo* and *Wendlendia exserta* are most common boundary plantations. *Casuarina equisetifolia* is extensively planted on field bunds and along sandy coastal areas in Orissa.

In many parts farmers grow trees in separate blocks as wood lots along with agricultural fields. Now the practice is expanding fast due to shortage of fuel wood and demand of poles or pulp-wood in industry. For example, bamboo poles are in great demand for orange orchards in Nagpur area and *Eucalyptus* and *Populus* for WIMCO Industries. These days' wood lots are being raised mostly on large farms due to the increase of labour costs and labour management, lack of irrigation and risk of crop investments. Wood lots of *Casuarina,* bamboo, poplar, *Eucalyptus*, *Leucaena leucocephala*, red sandal (*Pterocarpus santalinus), Dalbergia sissoo* etc. have become popular in many parts of the country.

Systems for Soil Conservation or Amelioration

About 150 million ha of land in India are subject to serious wind and water erosion, of which 69 million ha are critically affected. About 4 million ha area is suffering from degradation due to ravines and gullies, 11.3 million ha as riparian land, coastal sandy areas and steeply sloping lands and more than 9 million ha is salt affected. The deep and narrow gullies are best controlled by putting them to permanent vegetation after closure to grazing. Afforestation with suitable tree species like *Acacia nilotica, Azadirachta indica, Butea monosperma, Prosopis juliflora, Dalbergia sissoo, Tectona grandis,* species of *Bambusa* and *Dendrocalamus* and other adaptable species such as grasses like *Dichanthium annulatum, Bothriochloa pertusa, Cynodon dactylon* and *Sehima nervosum* will help in stabilizing the ravines and gullies and checking their spread. The beds of rivers may be stabilized by grasses like *Vetiveria zizenoides* and *Saccharum benghalensis* and tress like *Terminalia arjuna, Eucalyptus* and *Casuariana equisetifolia* have helped in stabilizing the coastal sand dunes. *Acacia tortilis, A. nilotica, A. senegal, A. jacquimontii, Prosopis cineraria,. P. juliflora, Azadirachta indica, Albizia* *lebbeck* and *Cassia siamea* have been found suitable for afforestation of sand dunes in arid regions along with grasses like *Cenchrus ciliaris, Lasiurus sindicus* and *Saccharum benghalensis*. These were found effective in arresting drifting of soil, which was as high as 1,450 tonnes/ha. The salt-tolerant tree species were used for grazing and shade. *Salvadora oleoides, Capparis decidua, Tecomella undulata, Zizyphus nummularia, Prosopis cineraria* and *Acacia nilotica* were common trees of arid lands. In recent times due to increase in population pressure these wood lots have shrunk at a fast rate.

Shelter Belt in Rajasthan

Arid regions witness very high wind velocity throughout the year. Farmers build shelter-belt (*kana bandi*) by either small dead wood or local vegetation to check wind velocity within safer limits. *Crotolaria burhia, Leptadenia pyrotechnica* and *Aerva pseudotomentosa* are planted in 20-25 m apart rows across the wind direction. Between the lines of these shrubs, grasses such as *Cenchrus ciliaris, C. setigerus Lasiurus sindicus* are planted on leeward side of each break. This permanent vegetation helps accumulate sand near them, which is again spread in the field. This also helps increase the crop yields along the lines.

Trees on Rangelands

As pointed out above, *Salvadora oleoides, Capparis decidua, Acacia nilotica, A.leucophloea, P. cineraria,* and now *Prosopis juliflora* also are most frequent trees on common community grazing lands. In tropics coconut is most common tree on pasture lands. Cattle raising usually involves grazing on these pastures. In some cases special fodder plants including legumes are also cultivated.

Aqua-forestry

Throughout the coastal regions (more evident along Andhra coast) farmers are cultivating fish and prawn in saline water and growing coconut and other trees on bunds of ponds. These trees help in producing litter feed to fishery and generate extra income to the farmer. Now fish culture in the mangroves is also advocated, which from a rich source of nutrition to the aquatic life and breeding ground for juvenile fish, prawn and mussels. Poultry is another adventure in some of these regions. A well-balanced system of animal husbandry including goatery, poultry, duck farming, turtles and fishes in the small ponds in home gardens make a balanced system of high moisture, energy and nutrient-use efficiency per unit area. The leaves of many trees, viz *Gliricidia sepium, Leucaena leucocephala, Moringa oliefera,* etc. have been found to serve as good fish feed when offered as pellets and improved its productivity.

Apiculture with Trees

The coastal population especially in Orissa, has been harvesting honey from the bees making hives on trees. Apiculture is now considered a profitable profession in many other parts. People are interested to go for this business by selecting different kinds of plantations. The forest trees are preferred for apiculture. Its scope is more prominent in the agro-forestry system with high floral diversity.

1.9.SUITABLE AREA FOR AGROFORESTRY

The following type of land can be assigned for agroforestry

- Cultivable land
- Field boundaries

- Along with farm roads and *nallah* sides affected by erosion.
- Pockets within cultivated holding where cultivation is not possible.
- Old fallows
- Cultivable waste
- Other areas like community or panchayat land etc. in which agroforestry can be incorporated.

1.10.SUITABLE TREE SPECIES FOR AGROFORESTRY

The selection of tree species should be such that the cultivation of arable crops traditionally grown on that site can be continued under the new system. Often initial selection of the tree species is made on the basis of their ability to generate higher cash income. At the later stage, after establishment of trees, new crops may be introduced that can adopt better with the existing tree species. Farmers generally do not like to change their old farming system due to strong link with their socio-cultural.

Table 1: Some common traditional agroforestry systems / practices:

System or Practice	**Agro-ecological adaptation**
Agrisivicultural system	
1. Shifting cultivation	In tropical forest areas
2. Taungya	In all regions
3. Home gardens	Mainly tropical region
4. Plantation-based cropping systems	Mainly humid tropical region
5. Scattered trees on farm lands	In all regions, specially semi-arid and arid region
6. Shelter belts and wind breaks	In wind - prone areas, all regions viz. coastal, arid, alpine areas

7. Boundary plantation and livehedges	In all regions
8. Wood lots for soil conservation	In hilly areas, along sea coast and ravine lands
9. Trees on rangelands	In all regions
10. Plantation crops with pastures and animal	Mostly humid and subhumid regions of South-East Asia andSouth Asia with less grazing pressure on plantation lands(trees+ crops+ animals/ pasture)
11. Industrial plantation with crops	Intensively cropped areas in northern India
12. Aqua-forestry	Low-lying lands
13. Apiculture with trees	Throughout the country
Silvi-pastoral	
14. Silvi-pasture	Subtropics and tropics with bio-edaphic sub climaxes
15. Horti-pasture	In hilly orchards for soil conservation and forage

traditions. Such changes can take place gradually, when the income level of the farmers increases and they start generating cash surplus. The following considerations should be kept in view while selecting the species

1. Suitability for growing under the prevalent agro-climatic conditions.

2. Utility of trees for meeting the needs of farmers for timber, fodder, fuel, fruit, fiber etc.

3. Preference may be given to indigenous and fast-growing species, and leguminous and other nitrogen-fixing species. Species that provide raw material for cottage industries should be encouraged.

1.11. TYPE OF TREE SPECIES

Though the primary concern is to keep up the production level of the arable crops, the following criteria are worth considering for planting trees under the agro-forestry system:

1. Non interference with arable crops;
2. Easy establishment;
3. Fast growth and short gestation period;
4. Non-allelopathic effects on arable crops;
5. Ability to fix atmospheric nitrogen;
6. Easy decomposition of litter;
7. Ability to withstand lopping;
8. Multiple use and high return; and
9. Ability to generate employment

It is extremely difficult to select species having the ability to fulfill all these criteria. Therefore the researcher and extension workers can choose some points for each criterion, in consultation with the farmers who are directly taking part in adopting agroforestry on their fields and select the species that score the most points.

1.12.TREE SPECIES BASED ON SPECIFIC UTILIZATION PURPOSE

Fodder-cum-fuelwood Species

Albizia amara, Albizia procera, Albizia lebbeck, Erythrina indica, Gliricidia sepium, Hardwickia binata, Leucanea leucocephala,Pithecellobium dulce, Prosopis cineraria, Sesbania grandiflora,, Sesbania sesban.

Fuel-wood and Timber Species

Acacia nilotica var. *cupressiformis* , *Acacia nilotica, Albizia lebbeck, Albizia procera, Azadirachta india, Cassia siamea, Casuarina equisitifolia, Dalbergia sissoo, Dendrocalamus strictus, Pongamia pinnata, Melia azadirach, Parkinsonia aculeata,Thespesia populnea.*

Softwood and Pulpwood Species

Ailanthus excelsa, Ailanthus tryphysa, Bombax ceiba, Paraserianthes falcataria, Populus deltoides Bamboo species.

Fruit and Vegetable Species

Annona reticulata, Annona squamosa, Artocarpus heterophyllus, Emblica officinalis, Moringa officinalis, Ziziphus mauritiana.

1.13. PRIORITY FOR SELECTION OF SPECIES

After the screening of the species to suit the agro-climatic conditions, the next aspect to be considered is profitability. Ideally the agricultural production of agricultural crop should not be affected. But in reality, farmers want to earn higher total returns. Rich farmers are able to take bold decisions but not small farmers, who like to earn more money but not at the cost of reduced food production. This is because home-grown food is the main source of subsistence and failure to harvest an adequate quantity of grains severely threatens their subsistence. Uncertainties about the marketing of wood can be greatly reduced by establishing a suitable marketing network to handle the agro-forestry produce.

1.14. SELECTION OF CROPS

To obtain full utilization of environmental resources and to increase economic benefits, an appropriate crop should be interplanted with or after the establishment of tree plantation in accordance with site and climatic conditions. During initial years of establishment the crops that require sufficient amount of sunlight are interplanted between the tree species. As the tree grows and their crown enlarges, causing considerable shade on the floor, especially during the growing season, some shade-tolerant crops or medicinal plants such as ginger, turmeric, elephant foot-yam etc. are selected for underplanting.

1.15. AGROFORESTRY APPLICATIONS

Farming System

Agroforestry is a form of natural resource management, since the resource management issues interact with other production systems as well. Technologies related to integrated production systems involving crops, livestock, perennials and fisheries needs to be addressed further with the changing economy. The value of commerce in agriculture would be appreciated and farmer's decisions on land use would be increasingly based on comparative advantage rather than on subsistence needs of the farm household. Therefore a major shift might be expected in agricultural production through diversification.

These shifts in production system will get further boost because of integration of world markets, urbanization and rising personal incomes. Further, to design appropriate farming systems suited to diverse farming situations, farmer's participation beginning from planning till execution of research programme will be inevitable and they would actually participate in research efforts. This bottom up approach will help the scientists in having a better perception of farm problems and enable them suggest eco-friendly resource use efficiently and economically in profitable farming-system strategies.

Resource Conservation

Water is a critical element for reclamation of degraded lands for sustainable biomass production, ultimately leading to a better quality of life and enabling conditions. Watershed management is an approach for area planning of natural resources, especially land, water and plants, to observe socio-economic needs of human society. The watershed management plan for treating for different parts should be decided by simple measures for protection of the resource base and created assets, improvement of productive system, generation of employment opportunities and ensuring higher income on a recurring basis.

Degraded land because of many limitations can only be improved through agroforestry, which control erosion, reduce run-off, improve *in-situ* soil-moisture conservation, increase water-table but also improve productivity as well as profitability. Researches involving agroforestry are still required on many areas like watershed hydrology, control of sedimentation, situation specific cost-effective technologies, production of fodder, forages, industrial grasses and medicinal plants for quick-return and livestock improvement programme for harnessing maximum benefits from limited biomass.

Carbon Sequestration

The Third Assessment Report of Inter-Governmental Panel on Climatic Change (IPCC) asserts that the earth's climate is changing and that its impact will be great on developing countries. To meet this global challenge of climate change, many countries and institutions have been working with a focus on analyzing the impacts, prospects for adaptation and opportunities for mitigation. India is a signatory to the Kyoto Protocol (1997), which asserts that the country will play an important role in mitigating the effects of global warming. Use of agroforestry systems, as mitigation strategy, is a key through a major opportunity for carbon sequestration. Concerted efforts are required to identify practical cost effective means through changes in land-use practices using agroforestry as an option.

Biodiversity Conservation

It is established that India is having rich vegetation with good biodiversity. According to the Government of India report, biological diversity is estimated to be over 45,000 plant species and 810,000 animal species, representing 7 % of the world's flora and 6.5 % of world's fauna. The UN Convention on Biological Diversity calls for conservation of the biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising out of the utilization of genetic resources.

Agroforestry innovations contribute to biodiversity conservation through integrated conservation-development approach. Forest degradation has caused immense losses to the biodiversity, which can be conserved through agroforestry by adopting a strategy of conservation through use. The biodiversity shall help in the development or improvement of new varieties or populations. It will further help in enhancing the availability of improved planting material, which is a key to increasy the productivity and production at farm level.

Improvement in Soil Fertility and Structure

Plantation of compatible and desirable species of woody perennials on farmland results in an improvement in soil fertility. There are several possible mechanisms of this, which include:

1. Increase in organic matter content of the soil through the addition of leaf litter and other plant parts

2. More efficient nutrient cycling within the system and consequently more efficient utilization of nutrient that are either inherently present in the soil or externally applied

3. Biological nitrogen fixation and solubilization of relatively unavailable nutrients, e.g. phosphate through the activity of mycorrhiza and phosphate-solubililising bacteria

4. Increase in the plant-cycling fraction of nutrients, with their resultant reduction beyond the nutrient-absorbing zone of the soil

5. Complementary interaction between the component species of the system, resulting in a more efficient sharing of nutrient resources among the components

6. Enhanced nutrient economy, because of different nutrient-absorbing zones of the root system of the component species

7. Moderating effect of additional soil-organic matter on extreme soil reactions and consequently improved patterns of nutrient- release ability.

Improvement in the organic matter status of the soil can result in an increased activity of the favourable micro organisms in the root zone. In addition to the nutrient relations, such microorganisms may also produce growth-promoting substances through desirable interaction and cause commensalistic effects on the growth of plant species. Inclusion of trees and woody perennials on farm lands can, in the long run, result in marked improvements in the physical conditions of the soil, e.g. its permeability, water-holding capacity, aggregate stability and soil-temperature regimes. Although these improvements may be slow, their net effect is a better soil medium for plant growth.

The role of trees in soil conservation and erosion control is one of the most widely acclaimed and compelling reasons for including trees on farm lands prone to erosion hazards. The beneficial effects of trees in this regard extends beyond protecting the immediate farm lands under consideration, to impart stability to the ecosystem and reduce the rate of siltation of downstream aquatic ecosystems, dams and reservoirs. The influence of trees on hydrological characteristics can extend from the microsite to the farm and regional levels. Although the effect of water use by a tree component on water availability to crop plants in different climatic conditions is not yet fully understood, there is evidence that the hydrological characteristics of catchment areas are favorably influenced by the presence of trees.

2.0.METHODOLOGY

The commonly cultivated list of agroforestry tree species for Tamil Nadu was compiled from the following references; 1) List of more common plants of Tamil Nadu and their uses (Ramanathan, 1982). 2) Flora of Presidency of Madras Volume II, II, III (Gamble, 1928). 3) Flora of Tamilnadu Carnatic: materials (Mathew, 1981) The state of Tamil nadu has seven broad agroclimatic zones and these are as follows: North eastern zone, North western zone, Cauvery delta zone, Western zone, Southern zone, Hilly zone and High Rainfall Zone. The distribution and usage of the Agroforestry species compiled for the current study has been presented as Table 2.

The current study was located in all the seven agro climatic zone of the state. A brief description of the zones is provided in Table 3. To ensure that all seven zones are represented in detail, study sites were selected for each zone. In all 26 districts, 600 samples were collected. Representative study localities were identified using certain criteria such as availability of samples, physiographic, and local variation, etc., the details are provided as Table 4. The investigation was conducted by the Junior Research Fellow, under the guidance of Care Earth and with the support of concerned Forest Range Officer in certain localities.

Two methods of investigation were used

- Direct interview.
- Non participant observation.

Table 2. List of Commonly cultivated agroforestry tree species in Tamil Nadu

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
1.	*Acacia leucophloea*	Velvel	Dry tracts of Tamil Nadu	Wood	Main Secondary timber & fuel wood
2.	*Acacia nilotica*	Karuvel	Dry tracts of Tamil Nadu	Timber	Good quality secondary timber & fual wood tannin gum used for calico printing and dyeing.
3.	*Aegle marmelos*	Vilvam	Dry tracts of Tamil Nadu	Leaves Fruit	Treatment of diabetes Antiseptic as unripe fruit astringent used in treating stomach disease, stomachic, ripe fruit in diarrhea dysentery. Fuel.
4.	*Ailanthus excelsa*	Thikuchimaram	Throughout Tamil Nadu (Except hills)	Wood Leaves	Wood is light used for match sticks packing cases, boats, toy & drums. All the parts viz leaves, bark, root are used as medicine. Good fodder for cattle.
5.	*Albizia amara*	Usil	Throughout Tamil Nadu (Except hills)	Wood Leaves Seeds	Making tool handles, and agri implements. Medicine and also green manure. Astringents

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
6.	*Albizia lebbeck*	Vagai	Throughout Tamil Nadu (Except hills)	Wood	Suitable to make furniture interior decoration, panelli, parquet & strip flooring, Agri. Implements and good for Produce gum & tannin.
				Bark	Green manure & fodder.
				Leaves	Roots, Leaves & seeds also used as a medicine.
7.	*Anacardium occidentale*	Mundhri		Seed	Edible
				Fruit	Edible
8.	*Anona squamosa*	Sitha	Throughout Tamil Nadu	Fruits	Edible
				Seed Powder	Destroys hair lice
				Roots	Strong Purgative
				Seed Kernels (30%Oil)	Soap making
				Wood	Fuel
				Leaves	Medicine
				Friut pulp	Making custard powder.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
9.	*Areca catechu*	Pakku	Foot hill of	Areca Nut	aromatic and astringent
			Tamil Nadu	Flowers	sweet-scented
				Borneo	Medicines- healing of the sick
				Seed	Used in beetal
10.	*Artocarpus heterophyllus*	Pala	Hill zone and	Fruits	Edible
			also Costal areas	Wood	Suitable for carpentry lay work, turnery & musical
			of Tamil Nadu		instruments. All the parts are used in various purposes.
11.	*Azadirachta indica*	Veppam	Throughout	Wood	Main secondary timber throughout Tamil Nadu
			Tamil Nadu		All other parts are used. All parts are highly medicinal.
			(Except hills)		
12.	*Bauhinia racemosa*	Athi	Throughout	Leaves	Medicine
			Tamil Nadu	Timber	Fuel & Furniture making
13.	*Bombax ceiba*	Vavu	Throughout	Wood	For boxes, general works & for ligh cabiner works,
			Tamil Nadu		match box toys ect.,
				Bark	Fiber & gum
				Fruits	Fibre, Roots, bark, fruit, and flower buds are used as medicine.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
14.	*Borassus flabellifer*	Palmyra palm	Dry tracts of Tamil Nadu	All parts	All parts are used; more than 800 products are prepared from Palmyra tree.
15.	*Butea monosperma*	Purasu	Southern parts of Tamil Nadu	All parts	All parts are used.
16.	*Calophyllum inophyllum*	Pinnai	East to West coast of Tamil Nadu	Seed oil	Treatment of Skin disease and rheumatism
				Leaves	Fish poison/bait
				Wood	Cabinet work, sleepers in ship industry for cooperage.
17.	***Carica papaya***	Papali	Throughout Tamil Nadu	Fruits, Leaves and Latex	Used medicinally
				Latex	Brewing and wine making and the textile and tanning industries.
18.	*Cassia fistula*	Sarakkonrai	Hill zone	Fruit, Leaves	Herbal medicine (burns, cancer, convulsion, delirium, diarrhea, dysuria, epilepsy, gravel, hematuria, pimples, syphilis)
				Leaves & bark	Vomiting, nausea, abdominal pain and cramps
19.	*Cassia siamea*	*Manjakkonai*	Throughout Tamil Nadu	Leaves	Organic fertilizer
				Wood	Fuel

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
20.	*Casuarina equisetifolia*	Savukku	Cultivated extensively in Tamil Nadu. Mailny coastal areas of Tamil Nadu	Wood	Used for poles, Beams for construction work and small furniture.
				Wood	Wood is used for fuel and charcoal
				Bark	Used for astringent
				Needles	Used for makingactivated carbon
21.	*Ceiba pentandra*	IlavaWhite silk cotton (Kapok)	Hotter parts of Tamil Nadu	Ripe fruits	Fiber
				Seed Oil	Edible
				Young leaves roots	Madicinal use
				Wood	Used for canoes to matches & bent work
				Oil cake	Cattle feed.
22.	*Chloroxylon swietenia*	Purasu	Dry tracts of all districts.	Bark	Astringent
				Leaves	Applied to wounds used in treatment of rheumatism
				Wood	Cabinet making, frames for carving ect.,
				Bark	Yields gum
				Wood	Yields yellow dye
				Leaves Seed	Antiseptic Seed oil

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
23.	*Citrus aurantiifolia*	Lemon	Throughout Tamil Nadu	Leaves & fruits	Medicinal value
24.	*Cocos nucifera*	Tengai, Thennai	Throughout Tamil Nadu (Highly Coastal area)	Whole plant	Fresh kernel is rich in protein, fat lignin, sugars and inorganic subatanches. oil is expressed from the dried flesh of the mutt. coconut water contains proteins, fats, minerals and carbohydrates, fermented toddy contains proteins, calcium and phosphorus. coconut oil contains free caprylic acid in addition to glycerides of lauric, myristic, palmitic and stearic acid.
25.	*Delonix elata*	Vadanarayanan	Throughout Tamil Nadu in road sides	Twigs	Live fances
				Wood	For churns, combs & matchesMedicinal value
				Leaves, bark	Manure
26.	*Delonix regia*	Mayirkonrai	Throughout Tamil Nadu	Wood	Good avenue tree, Wood for cheep items & as fuel.
				Seed	Seed gum edible used also in textile industry.
27.	*Diospyros chloroxylon*	Karuvakkanai	Throughout Tamil nadu	Ripe fruits	Edible
				Twigs	Good fodder
				Wood	General construction work, fuel.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
28.	*Emblica officinalis*	Malai nelli	Tropical region ofTamil Nadu	Fruit, Leaves & Bark	Medicinal purpose
29.	***Erythrina indica***	Kalyanamurungai	Hilly areas of Tamil Nadu	Shade Bark Wood	Tree for coffee plantation Yields fibre & tannin Fuel
30.	*Eucalyptus globulus*	Nilgiri thyla Maram	Throughout Tamil Nadu	Dry leaves, gum and oil, distilled from the fresh leaves Wood	Leaves contain volatile oil. Timber and fuel
31.	*Feronia elephantum*	Vila	Decidious region	Fruit, Leave	Medicinal
32.	***Ficus religiosa***	Arasamaram	Throughout Tamil Nadu	Root, Bark	Tannin & WaxMedicinal purpose
33.	*Grevillea robusta*	Silver oak	Hilly areas of Tamil Nadu	Leaves Bark gum Wood	Good manure Adhesive and in tanning industry Casks, cooperage plywood. Paneling work & also fuel.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
34.	*Hardwickia binata*	Aacha	Dry tracts of Tamil Nadu	Wood	Used largely for naves of carts, oil mills, ploughs, clod crushers, floors, bridges, wells, oars, pontoons, carving works, bench screws, lathe chucks, handles, sheaves of rope block railways keys, pegs, brake blocks.
				Bark	Red brown fibre for ropes & other agri. Purposes.
				Leaves & Youngbranches	Fodder & green manureFibre for cordage
35.	*Hibiscus tiliaceus*	Mallow tree	Coastal areas of Tamil Nadu	Whole plant	All the parts are very economical value.
36.	*Holoptelea integrifolia*	Aya	Throughout of Tamil Nadu	Wood	Brush backs, dusting brooms, good charcoal, industry cheap furniture, carving works, ploughs, yokes warper bobbins, combs & ect.,
				Bark	Pulp for insulation boards. Yellow oil in paint & as illuminant
				Leaves & Fruits bark Juice	EdibleApplied to rheumatic swellings.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
37.	*Jatropha curcas*	Katamanugu	Throughout Tamil Nadu	Fruits Wood	Edible Used as a secondary timber.
38.	*Manilkara zapota*	sapota	Tropical region of Tamil Nadu	Fruits	Fruits for ice cream and milk shake in its fresh form. Fruit can also be used for preparing liquor and alcohol because of its richness in sugar.
39.	*Melia azedarach*	Malaivembu	Throughout Tamil Nadu (Except hills)	Wood Leaves&twigs Leaves bark & fruits	Multiple use Cattle feed Insect repellent
40.	*Mimusops elengi*	Mahil	Southern District of Tamil Nadu	Plant Wood Dried Flowers Flower oil Ripe fruits	Is a good pollution indicatorBuilding purpose, piles, bridges oars, boats, masts etc., Anti bacterial, used for stuffing pillows etc., As per fume stimulant Edible

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
				Seed oil bark	Eaten and as illuminantFor tannina dn dueing
				Leaves	Fodder
				Young twigs	For cleaning teeth
				Bark and fruits	Tonic for dysentery
				Powdered	Flowered as snuff in headached and pain
				Seed paste	Ghee to remove constipation
41.	*Moringa oleifera*	Murungakai	Throughout Tamil Nadu	Leaves & fruits	vegetable
42.	*Morus alba*	Mulberry	North eastern	Leaves	Used for raring silkworms
			parts of	Wood	For the manufacture of sports goods.
			Tamil Nadu	Leaves	Cattle food
				Wood&bark	As medium grade fuel wood. Tanning purposes and
				Fibre	coloring cotton red.
				Twigs Bark & Leaves	In textile industryFor making basketsMedicinal uses.

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
43.	*Strychnos nux-vomica*	Etti	Dry region of Tamil nadu	Seeds & Wood	Homeopathic remedies for hangovers, back pain, digestive problems, headaches, allergies, colds, flu, emotional stress, constipation, menstrual problems, and hemorrhoids.
44.	*Pithecellobium dulce*	Konappuli, Kodukkapuli	Throughout Tamil Nadu	WoodFruits Fruits	firewood Food
45.	*Pongamia pinnata*	Pongam tree	Throughout of	Seed oilS Seed cake Wood Leaves Leaf Juice Hot Leaf	Used in tanning industry, soap making medicing for skin diseases, highly antiseptic as lubricant as fuel in diesel engine. Manure For ploughs cart, furniture, fuel and etc., Green manure, fodder In flatulence dyspepsia, diarrhea and cough Influsion as bath in rheumatic pain

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
46.	*Prosopis juliflora*	Velikathan	Throughout Tamil Nadu	Wood	The wood is used for parquet floors, furniture, and turnery items, fencepost, pilings, as a substrate for producing single-cell protein, but most of all for fuel. Toasted seeds are added to coffee. Bark, rich in tannin, is used for roofing in Colombia
47.	*Pterocarpus marsupium*	Vengai	Throughout Tamil Nadu	Bark & Leaves	Medicinal use
48.	*Pterocarpus santalinus*	Sensantanam	Throughout Tamil Nadu	Leaves Wood	It is used in the treatment of pimples, acne, wrinkles etc. It us also used internally in chronic bronchitis, gonorrhoea and gleet, chronic cystitis with benzoic and boric acids. Wood is used for making fancy articles and is much carved
49.	*Samanea saman*	Enal vagai			

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
50.	*Syzygium cuminii*	Naval	Throughout Tamil Nadu	Ripe fruits	Edible
				Seed powder	Medicine
				Unripe fruit	Preparing Vinegar diuretic carminative in nature
				Wood	Construction work boat, building industry, plywood, fuel.
				Bark extract	Medicine tanning dyeing
				Flowers	Good for honey cattle feed
				Leaves seed cakes, barks	Manure as illuminant and soap varnish
51.	*Tamarindus indica*	Puli	Throughout	Ripe fruit	Edible
				Pulp	Tartaric acid used in medicine
				Bark & Pulp	Used tanning and dyeing for polishing and cleaning metal wares
				Seeds	Yield jelly for making jams , marmaladed
				Seedspowder	Cattle feed
				Kernels	Edible after boiled
				Wood	Many uses also as fuel

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
52.	*Tectona grandis*	Teak	Throughout	Wood	First class timber
				Leaves, flowers	Tanning and Medicine
53.	*Terminalia chebula*	Kadukai	Dry region	Dried fruit	Medicinal purpose
54.	*Thespesia populnea*	Poovarasu	Coastal areas Tamil Nadu	Timber	For carts , Musical instruments, bent woeks, puddles, spokles, boats, rafter joints
				Wood	Agriculture implementation beams etc.,Fuel and tanning
				Wood&bark	Antiseptic used to treatment such as skin diseases Scabies ring worm , eczema.
				Bark leaves flowers&fruit	Fodder
				Leaves	Give yellow dye
				Fruit & Bark	Yield fiber

SI. No	Species	Tamil Name	Distribution	Parts used	Purpose
55.	*Wrightia tinctoria*	Palai	Throughout	Wood	Used in many works.
			Tamil Nadu	Bark Seeds	Medicine.
				Flowers	As vegetable.
				Fruit juices	Coagulant, Give blue dye
				leaves	

The method of direct interview, with the help of a data sheet was used for the study. All the farmers were interviewed either in their houses or in their farms on aspects such as agroforestry practices, rasing tree species and associated agricultural crops and usage of particular agroforestry species. Each interview lasted for about 30-45 minutes.

Non participant observation was also used in the study and the scope was to assess the socio-economic and intercropping practices of the farmers. A check list for this purpose was developed. The direct interviews were conducted at the house hold level covering all the 600 farmers. The interview schedule is presented as **Annexure I.** Individual, direct interview as a method has the advantage of a) Providing higher control by the investigator b) generating a higher amount of information and c) providing access to sensitive information. Observation enables collection of data on a larger, and often invisible, range of variables and allows a greater variety of interaction with community or the participants (Jaishree, 2000) Non participant observation especially on socio economic status of the agroforestry farmers were recorded by the investigator during the survey. The data that was obtained from the direct interview with farmers and non participant observations were pooled for analysis.

Table 3: Agroclimatic Zones of Tamil Nadu

Sl No	Name of the Zone	District	Annual rainfall	Soil type	Major crops	Dominant tree species	Major Agro forestry practices
1	North Eastern zone	Chennai Kanchipuram Thiruvallur Cuddalore Vellore Thriuvannamalai Villupuram	1054 mm	Red loam, red dandy loam, B lack clayey, and black clay loam to limited extend, saline alluvia in sea coast	Ground nut Sesame Rice Bajra Ragi and sugarcane	*Casuarina equistifolia* *Thespesia Populnea* *Ponagamia pinnata* *Lannea Coramendalica* *Anacardium occidentale*	a. Monoculture of *Casurina equisetifolium* b. Inter cropping a Ground nut, sesame and pulsed with *Casurania* c.Bund palnting of *Thespisia populea* and *Lannea coromendalica* d. Monoculture of *Acacia auriculiformise*. Inter cropping of groundnut, pulses and minor millets with *Anacardium occidentale*.

Sl No	Name of the Zone	District	Annual rainfall	Soil type	Major crops	Dominant tree species	Major Agro forestry practices
2	North Western zone	Dharmapuri, Krishnagiri	825 mm	Red to brown loamy soils	Ground nut tapioca Sugar cane and vegetables, Ragi, Sesame, Horsegram, and castor	*Delonix alata, Ponagamia pinnata,Ailanthus Excelsa, Albizia amara* and *Tamirindus indica*	a.Bund planting of *Pongamia pinnata*,(Dharmapuri), *Delonix alata, Albizia amara* (Salem). b. Intercropping tapioca with *Eucalyptus teriticornis*. c.Monoculture of *Eucalyptus tereticornis*
3	Cauvery Delta zone	Thiruchirapalli (Part of the district), Peramballur (Part of the district) Puddukotti (part of District), Thanjavur , Nagapattinam	900-1000 mm	Alluvial in the old delta and Red loam with pockets of laterite in the new delta	Paddy, Sugarcane, Banana, Pulses	*Thespesia populnea,* Bamboo, *Acacia nilotica, Prosopis juliflora,* Alianthus excelsa, *Casuriana equstifolia,Eucalyptus tereticornis,*	Bund palnting of Accacia nilotica and Bambusa bambooss, Intercropping Ground nut coriander with B.Bambos C. Boundary planting of *Tectona grandis* and Dalbergia sisoo along water courses and canals,Live fence of *Lannea coromendelica* Woodlots of *Terminalia arjuna*

Sl No	Name of the Zone	District	Annual rainfall	Soil type	Major crops	Dominant tree species	Major Agro forestry practices
4	Western zone	Erode, Coimbatore , Karur, Dindigul and theni	638 mm	Thin red with block soil	Rice, sugar cane , cotton, Sorgham, Ragi, Turmeric, Banana, Ground nut, Bengal gram,	Hardwickia binata, Holoptelia integrifolia, Alianthus excelsa, Acacia lecophlea, Acacia ferruginea, Santalum album	Bund planting of *Albizia lebback*, excelsesa, *Hardwickia binata,* b.Inbtercropping tapioca, ground nut sesame with *Euclyptus tereticornis*, Wood lots of Ceiba pentandra
5	Southern zone	Ramanathapuram, Thirneliveli Madurai Sivagangai Virudhu nagar And Thoothukudi	776 mm	Black clayey, Saline Coastal alluvial or river alluvium, Red sandy soil and deep red soil	Cotton, sorghum, fodder, sorghum, minor millets, groung nut, Chilli and Vegetables	Acacia Ceiba, Bassia latifolia, prosphus juliflora *Tamarindus indica*, *Eucalyptus*, *Azardirachta indica*	a. Woodlots of *Tamirind* b. B.Silipasture consist of *Lucaena* c.Intercroppin pulses with kapok d. Monoculture of Euclayptus teriticornis, Acacia nilotica, e. A. *Prosopis juliflora* f. Bund planting of Eucalyptus kapak

Sl No	Name of the Zone	District	Annual rainfall	Soil type	Major crops	Dominant tree species	Major Agro forestry practices
6	High rainfall zone	Kanya kumari	1500 mm	Deep loam , Saline coastal alluvium (South eastern belt)	Rice Tapica, Coconmut, peper, Clove, Nut mug, Cardomom and coffee.	Rubber , tamarind Calophyllum inophyllum and Albizia falcataria	a. Home garden b. intercropping food crops , spices and pastures with coconut c. Bund planting of Albizia falcataria d.Intercropping food crops with Calophyllum inophyllum. Bassia latifolia and Pongamia pinnata
7	Hilly zone	Chethery, Nilgris, Shevroys, Elagri, Javadhu,Koli, Anamala, Palani and Podhigai hill ranges	100 mm	Laterite	Tea, coffee, Cabbage, Cauliflower	*Grevillea robusta**Eucalyptus globulese* *Acacia* *Terminalia spp*	a. intercropping potato, beans with *Eucalyptus globules* *Grevillea robusta* and *Erthrina indica* as shade trees in tea and coffee gardens.

Table 4. Number of Farmers in each Locality

ZONE	LOCALITY	NAME OF LOCALITY	NO. OF FARMERS IN EACH LOCALITY
I North Eastern Zone	1.	Cudalore	12
	2.	Viruthachalam	9
	3.	Chithambaram	7
	4.	Kancheepuram	10
	5.	Chengalpat	11
	6.	Villupuram	8
	7.	Thirukovilur	12
	8.	Sriperunpudur	8
	9.	Thiruvallur	12
II North Western Zone	10.	Namakkal	12
	11.	Rasipuram	8
	12.	Salem	8
	13.	Omalur	9
	14.	Dharmapuri	12
	15.	Harur	14
	16.	Krishnagiri	13
	17.	Hosur	9
	18.	Pudukkottai	21
III Cauvery Delta Zone	19.	Thanjavur	13
	20.	Kumbakonam	10
	21.	Orathanadu	11
	22.	Perambalore	11

ZONE	LOCALITY	NAME OF LOCALITY	NO. OF FARMERS IN EACH LOCALITY
III Cauvery Delta Zone	23.	Thiruvarur	13
	24.	Mannarkudi	10
	25.	Trichy	9
	26.	Ariyalore	11
	27.	Lalgudi,	9
	28.	Theni	8
IV Western Zone	29.	Uthamapalayam	7
	30.	Periyakulam	11
	31.	Dindukal	14
	32.	Nilakkottai	8
	33.	Vedasadur	13
	34.	Natham	12
	35.	Karur	11
	36.	Aravankurichi	7
	37.	Krishnarayapuram	12
	38.	Kulithalai	8
	39.	Coimbatore	13
	40.	Pollachi	6
	41.	Udumalaipet	8
V High RF Zone	42.	Kanyakumari	12
	43.	Nagercoil	10
VI Hill Zone	44.	Chithery	11

ZONE	LOCALITY	NAME OF LOCALITY	NO. OF FARMERS IN EACH LOCALITY
VII Southern Zone	45.	Madurai	18
	46.	Sivagangai	22
	47.	Manamadurai	6
	48.	Ramanathapuram	12
	49.	Kamuki	8
	50.	Viruthunagar	13
	51.	Sivagasi	14
	52.	Tuticorin	12
	53.	Kovilpatty	10
	54.	Thirunelveli	10
	55.	Nanguneri	12
	Total		**600**

Data Collection and Analysis

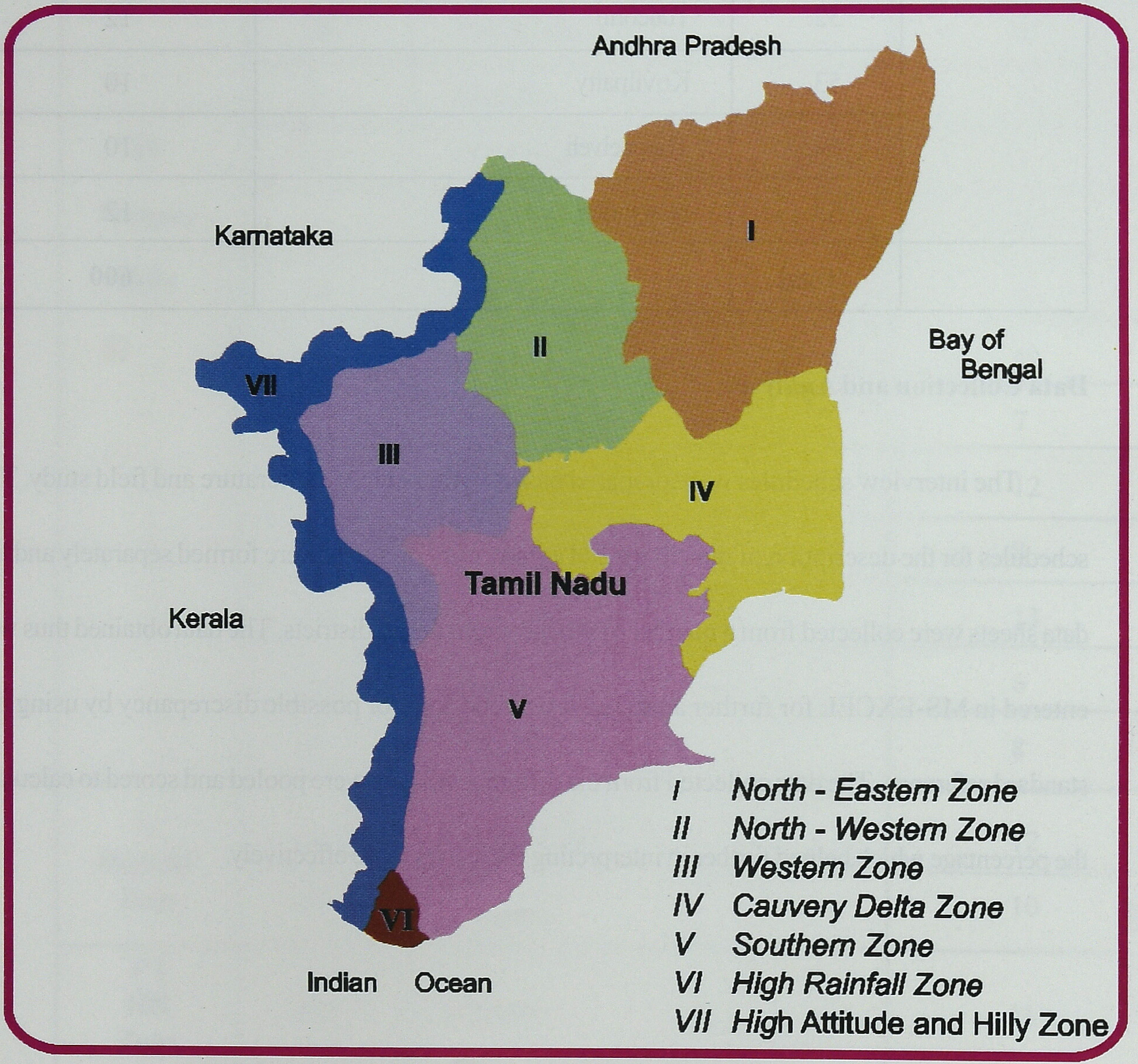
The interview schedules were prepared based on the review of literature and field study. The schedules for the description of the village and agroforestry products were formed separately and the data sheets were collected from a number of villages from the 26 districts. The data obtained thus was entered in MS-EXCEL for further analysis. It was checked for possible discrepancy by using the standard reference. The data collected from the different villages were pooled and scored to calculate the percentage which helped further in interpreting the results more effectively.

3.0.AGROCLIMATIC ZONES of TAMIL NADU

Agroclimatic zones portrays the Tamil Nadu economy and its environment. The features of the various Agroclimatic zones are presented in a detailed way to highlight the endowment of natural resources.

Based on soil characteristics, rainfall distribution, irrigation pattern, cropping pattern and other ecological and social characteristics, the State has been classified into seven agro-climatic zones. They are

Agro-climatic Zones of Tamil Nadu


Andhra Pradesh
Karnataka
Bay of Bengal
Kerala
Tamil Nadu
Indian Ocean
I
II
III
IV
V
VI
VII
I North - Eastern Zone
II North - Western Zone
III Western Zone
IV Cauvery Delta Zone
V Southern Zone
VI High Rainfall Zone
VII High Attitude and Hilly Zone

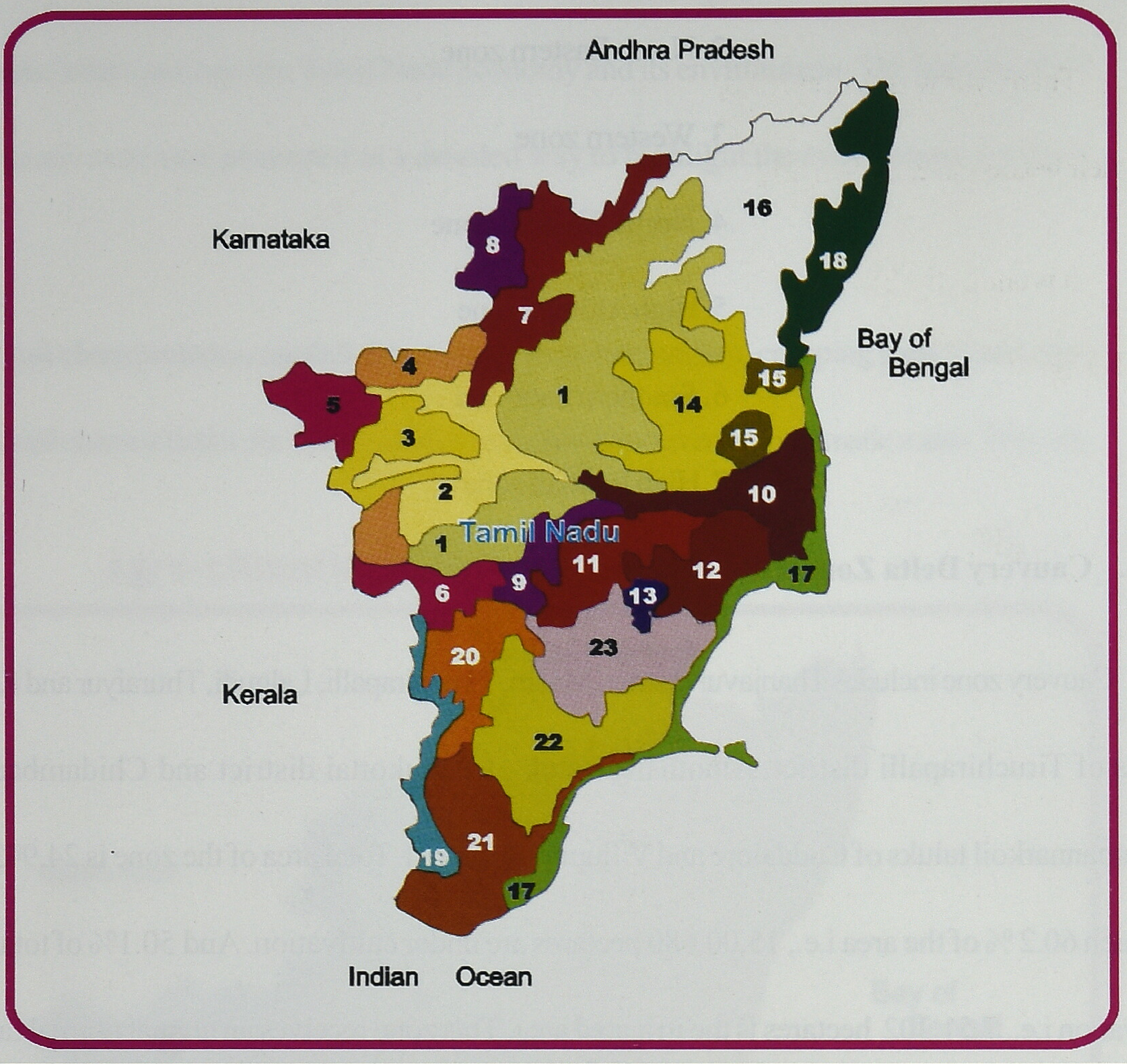
1. Cauvery Delta zone
2. North Eastern zone
3. Western zone
4. North Western zone
5. High Altitude zone
6. Southern zone and
7. High Rainfall zone

1. Cauvery Delta Zone

Cauvery zone includes Thanjavur district, Musiri, Tiruchirapalli, Lalgudi, Thuraiyur and Kulithalai taluks of Tiruchirapalli district, Aranthangi taluk of Pudukottai district and Chidambaram and Kattumannarkoil taluks of Cuddalore and Villupuram district. Total area of the zone is 24,943 sq.km. in which 60.2 % of the area i.e., 15,00,680 hectares are under cultivation. And 50.1% of total area of cultivation i.e., 7,51,302 hectares is the irrigated area. This zone receives an annual normal rainfall of 956.3 mm.

It covers the rivers of Cauvery, Vennaru, Kudamuruti, Paminiar, Arasalar and Kollidam. The major dams utilized by this zone are Mettur and Bhavanisagar. Canal irrigation, well irrigation and lake irrigation are under practice. The major crops are paddy, sugarcane, cotton, groundnut, sunflower, banana and ginger. Thanjavur district, comes under this zone.

Soil Map of Tamil Nadu


Andhra Pradesh
Karnataka
Bay of Bengal
Kerala
Tamil Nadu
Indian Ocean
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Sl. No	Soil Description
1.	Upland soils - Gravelly loam to gravelly clay
2.	Mixed Black and Red soils
3.	Mixed Red and Blsck soils
4.	Red Hills soils - loamy to gravelly clay
5.	Clay to gravelly clay
6.	Hills soils - loamy to gravelly clay
7.	Hills soils - loamy to clayey
8.	Red soils - loamy to clayey
9.	Gravelly loam to gravelly clay loam river bed soils
10.	Black river bed soils
11.	Poor base Red and lateritic soils
12.	Poor base Red and lateritic soils
13.	Poor base lateritic soils
14.	Black swell - shrink soils
15.	Poor base lateritic soils
16.	Gravelly loam, red and lareritic soils
17.	Sandy to standy loam waterlogged soils
18.	Typical beach sandy soils
19.	Hills soils - loamy to gravelly clay
20.	Mixed Red and Black soils
21.	Gravelly clay to gravelly loam red soils
22.	Black swell - shrink clay soils
23.	Poor base Red and lateritic soils

Thanjavur District

Thanjavur was the capital of Chola kings for many years and later Maratha rulers had this place as their headquarters. Even now, the Maratha Royal Family has their heir in Thanjavur.

It is one of the 28 districts in Tamil Nadu. The district was carved out from the composite district of Thanjavur, which had been trifurcated into Thanjavur, Thiruvarur and Nagapattinam. This district is a part of cauvery delta with rich and fertile soil. This district is contributing the major part of the food grains particularly paddy to the state pool and hence popularly known as “Rice Bowl” of Tamil Nadu and “Granary of South India”. A very old and efficient canal irrigation system has facilitated agriculture to be the main occupation of the population. The “Stanley Reservoir” constructed during pre-independence period across Cauvery River at a distance of about 200km northwest of Thanjavur is still serving as the chief source of surface water irrigation in Thanjavur delta. It is bounded by Tiruchirapalli, Ariyalur and Cuddalore districts in the north, Pudukkottai district in the west, Bay of Bengal in the south and Thiruvarur and Nagapattinam districts in the east. The district lies between 90 50’ and 110 25’ northern latitude and 78^0 45’ and 79^0 25’ of eastern longitude. The soil is fertile because of the deltaic terrain and greater part of the district consist of an undulating plain bisected by the valley of Cauvery. The climate is tropical and the district falls under the category of medium and high rainfall region with average rainfall around 1020 mm. Majority of the rain is received through North East Monsoon (October to early December).

The economy of the district is basically agriculture and about 75% of the work force is depending on agriculture. Paddy is the main crop of the district and raised in nearly 60% of the cropped area. Sugarcane, groundnut, pulses, gingelly and coconut are the other important crops cultivated in the district. Surface irrigation is the main source of irrigation. Cauvery, Vennar, and Grand Anaicut Canal with their subsidiaries viz. Vettar, Kudamurutti, Thirumalairajan, Veerachozhan, Arasalar, Agniyar, Kalyana Odai and Poonaikuthi river constitute the irrigation system of the district.

2. North Eastern Zone

The area covered by this zone is Chengleput district, North Arcot district, Cuddalore and Villupuram district excluding, Chidambaram and Kattumannarkoil taluks and Ariyalur taluk of Tiruchirapalli district. The total georgraphical area of the zone is 31,194 Sq. kms. The total geographical area of the zone is 32,194 Sq. kms. The area under cultivation is 50.5 %of the total area of cultivation. The annual normal rainfall is 1109 mm. The major rivers are Palar, Ponniar, Cheyar, Vellar, Thenpennai, Manimuthar and Komugi.

Major dams used for irrigation are Mettur, Sathur, Veedur, Komugi, Manimuthar and Wellington. Canal irrigation, well irrigation, Irrigation by lakes and by dams is under practice. The major crops are paddy, cholam, cumbu, ragi, groundnut, sugarcane and cashewnut. Chengleput district which is known as "Lake District" and also where the popular "Madhurandhagam lake" is presents this zone.

Villupuram District

Villupuram District was formed by bifurcating the erstwhile composite South Arcot District. Villupuram is the district Headquarter. It is the fourth largest district in Tamil Nadu and is predominantly an agriculture district. The boundaries are Bay of Bengal and the Union Territory of Pondicherry in the East; Kanchipuram and Tiruvanamalai districts in the North; Cuddalore district in the South and Dharmapuri and Salem districts in the West. Plains excepting Kalrayan Hills and Gingee Hills characterize the entire district. There are eight taluks sub-divided into twenty-two blocks with red soil, sandy loam and black cotton soil mainly accounting for the soil structure.

Pennar, Gadilam, Gomukhi, Malattar and Sankaraparani are the rivers flowing in the district. The district is underlined by hard rocks of Archaean age in the west followed by the sediment Aries comprising of the clays and sand stones in the east. Artesian conditions exist at places in sediment Aries. About 86 % of the active workers in the district are engaged in agriculture. Land holdings are highly fragmented and about 89.7% of the land holdings are less than 2 ha. Forest area constitutes about 8% of the total area of the district spreading over the areas bordering Salem, Dharmapuri and Thiruvannamalai districts. The Coastal length of the district is about 30 km in Marakannam and Vanur blocks, the district offers good scope for setting up of agroprocessing industries.

As per the latest census data, the SC/ST population in Villupuram District is about 7.73 lakhs forming 30% of the population of the district. Thus there is a very good scope for voluntary agencies to play a major role for the upliftment of the downtrodden.

3. Western Zone

It covers Periyar district, Coimbatore district, Tiruchengode taluk of Salem district, Karur taluk of Trichirapalli district and Northern part of Madurai district. This zone constitutes an area of 15,678sq.km. The area under cultivation is 6,98,105 hectares which is 44.5 % of the total area. And only 42.4 % of the area under cultivation is the irrigated area i.e., 2,96,201 hectares. The annual normal rainfall is 653.7 mm. Cauvery, Noyal, Bhavani, Uppar, Sirvani and Amaravathi are the major rivers and Mettur, Bhavanisagar and Amaravathi are the major dams utilised by the zone.

Erode District

Erode district with a geographical area of 7505.58 Sq. kms is divided into 7 taluks and 20 blocks. The district has 539 revenue villages and the population is 23.20 lakh. Out of the geographical area of 8.16 lakh ha, about 3.09 lakh hectares constitute cultivated area forming 37.9 % of the total geographical area. Forest cover is about 2.29 lakh hectares and account for 28.1 per cent of the total geographical area of the district. The district falls under the agroclimatic zone of southern Plateaus and Hills. The district enjoys semiarid, dry sub humid climate. The Soil Survey and Land use Organisation, Coimbatore has identified about 30 soil series. A major part of the district is covered with red soils. Alluvial Soils are found in small patches along Noyyal and Bhavani rivers. The district forms part of Cauvery River Basin and is blessed with a network of rivers viz., Bhavani, Noyyal, Amaravathi and their tributaries. The river Cauvery flows along the eastern border of the district. The normal rainfall in the district is 717 mm.

Second largest turmeric market of the country is located at Erode. During the previous year, a turmeric trading centre was completed in Perundurai estate on land extending over 50 acres at a cost of Rs. 30.00 crore to facilitate about 200 traders to carry our regular trading in turmeric. The district is the largest producer of turmeric in the state with over 10,000 hectares in the being cultivated here. Groundnut crop is also being raised .

The northwestern part of the district which includes Thalavadi, Sathyamangalam, Gobichettypalayam, BhavaniSagar, Bhavani, Andhiyur, Ammapet blocks is flanked by the southern slopes of Eastern Ghats. Southern slopes of Eastern Ghats flank the maximum elevation noted on the ghat. The maximum elevations noted on the ghat section are 1439m. This district form the part of

Cauvery basin and contributes several tributaries viz., Bhavani, Noyyal, Uppar, Vattamalakkarai, Amaravathi, Shanmuganandhi and Nallanthangal Odai. These tributaries drain the district area into the river Cauvery. There are many irrigation projects namely Lower Bhavani Project across Uppar river, Vattamaalakarai odai. Because of these projects, there is a well-built surface water irrigation network covering the major part of the district. Amaravathi River alone passes through the southern part of the district to the confluence in Cauvery in Karur district. The presence of these tributaries have helped much of the district to get number of good protected water supply through comprehensive water supply from river sources.

4. North Western Zone

The zone covers the Dharmapuri district excluding hilly areas, Salem district excluding Thiruchengodu taluk and Perambalur taluk of Tiruchirapalli district. This zone covers an area of 18,271 Sq. kms in which 10,28,097 hectares, which is 56.3 per cent, is under cultivation. Out of total area of cultivation, only 23 percent i.e., 2,35,828 hectares are the irrigated. The annual normal rainfall of the zone is 849 mm. This zone has been identified as moderately drought prone. The major rivers of this zone are Cauvery, Thenpennai and Manimuthar. Mettur and Krishnagiri are the major dams in this zone. Paddy, wheat, maize, ragi, sugarcane, groundnut, cotton, sunflower, tobacco and mango are the major crops of this zone. Forest area in this zone constitutes nearly 30% i.e. 5,35,282 hectares of the area of the zone, which is nearly 25 % of the total forest area of the State.

Dharmapuri District

Dharmapuri district was carved out from the Salem District on 1965 with its head quarters at Dharmapuri. The district with a geographical area of 9619.18 Sq. kms is situated on north western corner of Tamil Nadu State. It is one of the most backward and drought prone districts of the State. The district receives rainfall from the South-West monsoon and North East monsoon. Two major rivers viz. Cauvery and Thenpennar and their tributaries flow through this district. The gross and net irrigated areas are 1,44,543 and 1,17,883 hectares respectively. For administrative convenience, the district has been divided into 10 taluks and 18 blocks. Dharmapuri district has good scope for minor irrigation.

The State Ground Water Department conducts periodical surveys and classifies the ground water potential of the district. On the basis of the latest study, 7 blocks viz. Bargur, Dharmapuri, Harur, Krishnagiri, Mathur, Palacode and Pappireddipatti are categorized as DARK, 4 blocks viz. Karimangalam, Uthangarai, Kaveripattinam and Veppanapalli as GREY and the remaining 7 blocks as WHITE. There are 2 research institutes. The soil types ranging from black to mixed loam red sandy soils are seen in Hosur and Harur taluks. Black and loam soils are found in Dharmapuri and Krishnagiri Taluks.

Generally, the soil is low in Nitrogen and Phosphate content with no marked variations between taluks. The climate is generally warm and dry whereas the places bordering Karnataka State are cool. The temperature ranges from 17ºC to 37ºC. The annual average rainfall is 857mm. Due to the congenial climatic conditions, the district offers good scope for cultivation of fruits and vegetables and floriculture for export oriented market.

5. High Altitude Zone

This zone covers the Nilgiris, Kodaikanal, Shevroy, Elagir Javadhi, Kollimalai, Pachamalai, Yercaud, Anamalais, Palani and Podhigaimalai. This zone covers an area of 2,549 sq.kms. The area under cultivation is 73,689 hectares, which is only 28.9 % of the total geographical are a of the zone. Furthermore, only 0.84 per cent of the total cultivated area is irrigated i.e., 621 hectares. The annual normal rainfall is 1857 mm. There are no dams for irrigation in this zone since there are no major rivers. Paddy and groundnut are cultivated in relatively less extent. The major crops are tea, coffee and vegetables. Forest area is 1,50,139 hectares which is 58.9 % of the total geographical area of the zone.

Nilgiris District

The Nilgiris popularly known as *"Blue Mountains"* is a tiny district on the Western Ghats located between 11°10' and 11°45' N latitude and 76°14' and 77°2' E longitude. It is bordered by Kerala state in the North-West, Karnataka State on the North, Coimbatore District on the South East and Erode District on the North East. Though situated in the tropical zone, the district enjoys a subtropical to temperate climate by virtue of its altitude and this has contributed to development of the district as a well known tourist place. Tourism is a major factor contributing to the economy of the district.

The district experiences an average minimum and maximum temperature of 5.1° C and 24°C. With a geographical area of 2544 Sq. Kms, it is the second smallest district in the State of Tamil Nadu. The district is divided into 2 natural zones viz. the Nilgiris Plateau and the Wynad. Ooty (Udhagamandalam), the District Head Quarters is one of the finest tourist destinations of Southern India for administrative purpose, the district has been divided into 4 blocks, viz., Udhagamandalam, Coonoor, Kotagiri and Gudalur.

The entire district is hilly with a minimum and maximum height of 750 meters and 2650 metres above MSL. The highest peak is at Doddabetta. The average rainfall in the district is 1856.5mm and it is as high as 3000 mm locally.

Forests occupy 56.37 % of the total geographical area. The main forest produces are sandalwood, bamboo, teak, eucalyptus, blue gum and wattle. Despite high rainfall, irrigation facilities available in the district are poor. Irrigated area constitutes only 7.8% of the total cultivated area. Bhavani and Moyar are the two main rivers flowing through the district. Significantly, all the four blocks in the district are classified as 'White'. The soil formation is classified into 4 varieties, viz., black soil, brown soil, yellow soil and red soil.

Tea is grown in about 66% of the cropped area and it is in the mainstay of the economy of the district. The district accounts for a third of the total tea production from South India. Coffee comes next to tea in terms of area coverage. Potato is the third major crop after tea and coffee and the Nilgiris district accounts for three fourth of the total potato production in the State. Paddy and cereals are grown on a limited scale mainly in Gudalur area, which is the only terrain suitable for such crops. Major vegetable crops grown in the district include potato, cabbage, carrot, beans, radish, cauliflower etc. Orange, Jackfruit, Plum, Peach, Apple and Mango are the major fruits cultivated in the district. Apart from these, spices like cardamom, garlic, pepper, and ginger are grown in a limited scale.

6. Southern Zone

This zone comprises the districts of old Ramanathapuram, Nellai Kattaboman, V.O. Chidambaranar, Kamarajar and Dindigul taluk of Anna district, Natham, Melur, Thirumangalam, Madurai South and Madurai North taluks of Madurai districts and Puddukottai district excluding Aranthangi taluk. This zone constitutes an area of 36,655 sq.kms. The total area under cultivation is 16,50,250 hectares which is 45 per cent of the total area.

Around 44 % of irrigated area out of the area under cultivation is 7,22,166 hectares. This zone is prone to frequent drought. The annual normal rainfall is 816.5mm. It covers the rivers of Vaigai, Sitrar, Thamraparani, Numbiar, Pachaiyar, Kludar, Arjunar, Kodumudiyaar, Manimuthar, Periyar and Vaigai. The dams used by this zone are Periyar, Vaigai, Manjalar and Bhabanasam. The patterns of irrigation are well irrigation, canal irrigation, irrigation by dams and by lakes. Paddy, cholam, cumbu, ragi, groundnut, cotton, banana and tobacco are the major crops.

Ramanathapuram District

Ramanathapuram District in its present form came into existence from 1985 trifurcating the composite Ramanathapuram District. It is surrounded by Pudukottai District to the North, Sivaganga and Virudhunagar districts on the North West and West, Tirunelveli, Tuticorin districts and Gulf of Mannar on the south and Palk Strait on the East. The district has a geographical area of 408957 hectares, with a normal net sown area of 183651 hectares. The district is the most backward district in the State. Most of the soil types found throughout the district. A small portion of alluvial soils is found in Kamuthi, Muthukulathur, Paramakuddi and Tiruvadanai taluks.

7. High Rainfall Zone

This zone consists of only Kanyakumari district which is the smallest.The total geographical area is 1,684 Sq. kms, in which 63.1 per cent of the area i.e. 1,06,260 hectares are the area under cultivation. And 47.4 % of the total area under cultivation is the irrigated area i.e., 50,349 hectares. This zone receives an annual normal rainfall of 1456mm. It covers the rivers of Pazhaiyar, Kothair and Paraliyar. And the dams utilised by this zone are Pechiparai, Periyar, Sitharu Dam-1 and Sitharu Dam-2. The major pattern of irrigation is river irrigation. Paddy, coconut, vegetables, tea, cashewnut, banana and rubber are the major crops.

Kanyakumari District

Kanyakumari district lies at the Southern most tip of the Indian peninsula at the confluence of Indian Ocean, Bay of Bengal and the Arabian Sea. It is the smallest district in Tamil Nadu and bounded by Tirunelveli district in the East and North, Kerala State in the West and the tri-seas in the South. This district has a variety of natural landscapes ranging from the hills to the coast.. The district is a fertile land having more area under forest and plantations. Rivers and forests are the important source of irrigation. Thamiraparani, Pazhayar and Valliyar are the major rivers in the district. Favourable agro-climatic conditions enables to the cultivation of variety of crops etc.

The district has a unique advantage of rainfall during both the Southwest & Northeast monsoons. The period of Southwest monsoon is June to September while that of Northeast monsoon is October to December. The temperature ranges from 22.6 to 32.1 degree centigrade. The rainfall is generally high in the northern part of the district. The average rainfall is 1457 mm/annum

Agriculture is the major activity in the district. Out of the total geographical area of 1672 sq.km, the net area sown is about 815 sq.km. Irrigation is practised mostly in plains and the principle crop of the area is paddy.

Other crops like groundnut are also cultivated in smaller extent of the area; coconut plantation is common in the southern plains. Rubber plantations are common in the northern hilly terrain. Major irrigation sources are Pechiparai and Perunchani dams and they serve the plains in the district, with network of 53 canals, running to a total length of 540 km.

4.0.RESULTS

The results of the study have been organized under 5 sections and discussed in detail.

- **Agroclimatic Zone Profile of the Study Sites**

For the survey all seven agroclimatic zones in Tamil Nadu were included. Agroclimatic zones are classified based on soil type, rainfall, temperature i.e. based on the climatic and edaphic factors of the particular locality or district. 26 study sites were identified and surveyed to represent the entire range of the seven agroclimatic zones of Tamil Nadu. The seven agroclimatic zones along with the localities surveyed are given below in Table 5

TABLE 5. LOCALITIES SELECTED FROM EACH AGROCLIMATIC ZONE

SL. NO.	AGROCLIMATIC ZONES	LOCALITIES
1	North Eastern zone	Cudalore
		Cudalore
		Viruthachalam
		Chithambaram
		Kancheepuram
		Chengalpat
		Thiruvannamalai
		Villupuram
		Thirukovilur
		Sriperunpudur
		Thiruvallur
		Namakkal
		Rasipuram

SL. NO.	AGROCLIMATIC ZONES	LOCALITIES
2	**North Western Zone**	Thiruchankodu
		Salem
		Omalur
		Erode
		Gobichettipalayam
		Dharmapuri
		Harur
		Krishnagiri
		Hosur
		Pudukkottai
3	**Cauvery Delta Zone**	Thanjavur
		Kumbakonam
		Orathanadu
		Perambalore
		Thiruvarur
		Mannarkudi
		Trichy
		Ariyalore
		Lalgudi,
		Theni

SL. NO.	AGROCLIMATIC ZONES	LOCALITIES
4	**Western Zone**	Uthamapalayam
		Periyakulam
		Dindukal
		Nilakkottai
		Vedasadur
		Natham
		Karur
		Aravankurichi
		Krishnarayapuram
		Kulithalai
		Coimbatore
		Pollachi
		Udumalaipet
5	**High RF zone**	Kanyakumari
		Nagercoil
6	**Hill zone**	Chithery
7	**Southern zone**	Madurai
		Sivagangai
		Manamadurai
		Ramanathapuram
		Kamuki

SL. NO.	AGROCLIMATIC ZONES	LOCALITIES
7	Southern zone	Viruthunagar
		Sivagasi
		Tuticorin
		Kovilpatty
		Thirunelveli
		Nanguneri
		TOTAL 26

- **Profile of Data Size:**

Each agroclimatic zone was represented by varying number of localities. The Southern Zone had maximum number of localities (136) followed by Western Zone (114), then comes the Cauvery Delta Zone (108), the North Western Zone (104), the North Eastern Zone (103), the High Rainfall Zone (24), and finally the Hilly Zone (11). Description of the 26 study sites is provided in the following tables.

In the absence of a centralized database on agroforestry, availability of the samples was the key criteria for the interview. Further details of number of farmers in each locality are given in Table 6.

TABLE 6. LIST OF DISTRICTS SURVEYED

SL.NO.	NAME OF DISTRICTS	No. of FARMERS
1.	Madurai	26
2.	Sivagangai	22
3.	Ramanathapuram	23
4.	Viruthunagar	26
5.	Tuticorin	25
6.	Thirunelveli	24
7.	Kanyakumari	24
8.	Theni	23
9.	Dindukal	21
10.	Karur	23
11.	Namakal	20
12.	Puddukottai	21
13.	Tanjore	22
14.	Thiruvarur	23
15.	Thiruchirapalli	15
16.	Ariyalore	22
17.	Perambalore	25
18.	Cudalore	24
19.	Salem	24
20.	Dharmapuri	30

SL.NO.	NAME OF DISTRICTS	No. of FARMERS
21.	Krishnagiri	25
22.	Coimbatore	25
23.	Kancheepuram	25
24.	Villupurum	14
25.	Vellore	15
26.	Thiruvalur	15
	TOTAL DATA SIZE	**600**

- **Profile of Agroforestry System Integrated in each Agroclimatic Zone**

The agroforestry practices of the study sites are entirely dependent of the zone. Each zone however has one or two traditional agroforestry farming systems; these are being discussed in detail. To start with, in the North Eastern Zone; groundnut, vegetables, Brinjal, Banana, Rice, Black gram, Red gram, Pulses, and Pearl millet (Cumbu) are intercropped with *Casuriana equisetifolia, Tectona grandis, Anacardium occidentale, Cocous nucifera, Azadirachta indica, Ceiba pentandra and Tamarindus indica*. It was noted during the study that, groundnut was intercropped with Casuarina (during the first two years of the growing season*). Casuarina equisetifolia* is one of the important and fast growing tree species and it is used as raw material in paper industries. It is found to be highly suitable for sandy soils. In most cases Gingelly, Pulses, Red gram, and Black gram, were found to be intercropped with *Anacardium occidentale.*

In the North Western Zone; Groundnut, Fodder crops, Cotton, Pulses, Sorghum, Horse gram, Vegetables, Rice, Ragi, Pearl millet, Banana, and Onion are intercropped with *Tectona grandis, Mangifera indica, Tamarindus indica, Cocus nucifera*, *Azadirachta indica, Borassus flabellifer* and *Casuarina equisetifolia*. Groundnut, Fodder crops, Sorghum are the major intercrops for *Mangifera* indica. The climatic and edaphic conditions of the zone are highly suitable for *Mangifera* indica. Hence, the quality and quantity of mango production is also very high compared to any other part of Tamil Nadu. The other important agroforestry model is Cocos nucifera and *Tectona grandis* based silvi horticulture system.

The third case is the Cauvery Delta Zone; where Onion, Groundnut, Cotton, Pulses, Fodder crops, Vegetables, and Banana are intercropped with *Eucalyptus tereticornis Emblica officinalis,* *Bambusa bambos, Azadirachta indica, Casuarina equisetifolia, Ailanthus excelsa, and Tectona grandis.*

The next zone to be discussed is the Western Zone. In this zone Sugarcane, Cotton, Cowpea, Tapioca, Rice, Sorghum, Banana, Jasmine, Vegetables, Turmeric, Tomato Medicinal plants, Onion, Beetroot, Flowers, Fodder crops, Sapota, Gooseberry, and Pulses are intercropped with *Tectona grandis, Ceiba pentandra, Cocos nucifera, Azadirachta indica, Ailanthus excelsa, Casuarina equisetifolia, Emblica officinalis, Mangifera indica, Simaruba glauca, Tamarindus indica, Borassus flabellifer, and Prosopis juliflora.* The most important agroforestry model is *Ailanthus excelsa* based silvipasture and agri silviculture undertaken in areas in and around Coimbatore. This is mainly due to the presence of the match wood industry located in Annur area. *Ailanthus excelsa* is planted on the boundary of the fields. *Murrya kuinji*, Fodder crops, Sugarcane, Banana, and Turmeric are the important intercrops for *Ailanthus excelsa* based agroforestry system. Other agroforestry models include intercropping with Tectona grandis, *Ceiba pentandra, Cocos nucifera, Azadirachta indica, Casuarina equisetifolia, Tamarindus indica, Emblica officinalis,* and *Mangifera indica.*

The High Rainfall Zone is small in area when compared to the other six zones. Here the main agroforestry pattern is home garden, because it is adjoining Kerala. Home gardens are intercropped with *Pongamia pinnata, Delonix regia, Eucaliptus tereticornis,* and *Artocarpus heterophyllus.*

In the High Altitude and Hilly Zone tea and coffee are mainly raised because of the suitability of local conditions. The most important silvihorticulture models here are of Tea with *Brachylaena discolora*, and Coffee with *Erythrina indica*.

Finally in the Southern Zone; Sorghum, Groundnut, Vegetables, Cotton, Pulses, Rice Flowers, and Fodder crops intercropped with *Casuarina equisetifolia, Simaruba glauca, Emblica officinalis, Tamarindus indica, Tectona grandis, Azadirachta indica, Borassus flabellifer, and Prosopis juliflora.* It is an area with low rainfall with large dry tracts. The land is not suitable for the cultivation of agricultural crops. In *Borassus flabellifer* based agroforestry system fodder crops are intercropped. *Prosopis juliflora* based agroforestry system is also highly followed in Tirunelvelli and Ramanadu areas because; Prosopis is highly in demand for charcoal preparation and also highly drought tolerant. The intercropping pattern details are given in Table 7.

Table 7. INTERCROPING PATTERNS

Zone	Locality	Intercrops	Tree spp.
North Eastern Zone	Cudalore	Ground nut, Vegetables	*Casuarina equisetifolia*
	Cudalore	Gingelly and Groundnut	*Tectona grandis, Cocos nucifera*
	Viruthachalam	Gingelly	*Anacardium occidentale*
	Chithambaram	Brinjal	*Anacardium occidentale*
	Kancheepuram	Ground nut, Vegetables	*Anacardium occidentale,* *Cocos nucifera*
	Chengalpat	Vegetables, Ground nut, Rice	*Tectona grandis*
	Thiruvannamalai	Gingally, ground nut, Banana	*Azadirachta indica*
	Villupuram	Ground nut, gingally, pulses	*Ceiba pentandra*
	Thirukovilur	Pearl Millet (Cumbu), Ground nut	*Anacardium occidentale*
	Sriperunpudur	Red gram, Pulses	*Anacardium occidentale*
	Sriperunpudur	Black gram, red gram	*Anacardium occidentale*
	Thiruvallur	Gingelly, ground nut	*Anacardium occidentale,* *Tamarindus indica*

Zone	Locality	Intercrops	Tree spp.
North Wesrern Zone	Namakkal	Ground nut	*Casuarina equisetifolia*
	Rasipuram	Fodder crops, Rice	*Mangifera indica*
	Rasipuram	Fodder crops, Cotton	*Tamarindus indica*
	Rasipuram	Fodder crops, Ground nut	*Tamarindus indica*
	Thiruchankodu	Agriculture crops (pulses)	*Tamarindus indica*
	Salem	Sorghum	*Mangifera indica*
	Omalur	Sorghum	*Cocos nucifera*
	Erode	Sorghum	*Mangifera indica*
	Gobichettipalayam	Vegetables, Sorghum	*Cocos nucifera, Tectona grandis*
	Dharmapuri	Horse gram, Sorghum	*Mangifera indica, Azadirachta indica*
	Harur	Ground nut, RiceCottton	*Tectona grandis, Mangifera indica* *Cocos nucifera*
	Krishnagiri	Sorghum, ragi, cumbu.	*Tectona grandis, Mangifera indica*
	Hosur	Vegetables, Rice, Sorghum	*Tectona grandis, Cocos nucifera*
	Hosur	Sorghum, Ground nut, Vegetables	*Tectona grandis, Azadirachta indica, Borassus flabellifer,* *Mangifera indica*
	Pudukkottai	Banana, Ground nut, Onion, Flowers, Sorghum.	*Tectona grandis,* *Casuarina equisetifolia*

Zone	Locality	Intercrops	Tree spp.
Cauvery Delta Zone	Pudukkottai	Ground nut	*Emblica officinalis*
	Thanjavur	Onion, Cotton	*Eucalyptus tereticornis*
	Kumbakonam	Cotton	*Bambusa bamboo*
	Orathanadu	Pulses	*Azadirachta indica*
	Perambalure	Ground nut, Onion.	*Casuarina equisetifolia*
	Thiruvarur	Onion, Cotton	*Ailanthus excelsa*
	Mannarkudi	Ground nut	*Bambusa bambos*
	Trichy	Pulses, Fodder crops	*Azadirachta indica, Tectona grandis*
	Ariyalore	Fodder crops	*Mangifera indica*
	Lalgudi,	Vegetable, Banana	*Eucalyptus tereticornis*
	Perambalore Theni	Fodder crops, pulses, vegetables	*Eucalyptus tereticornis, Azadirachta indica, Tectona grandis, Casuarina equisetifolia., etc*
Western Zone	Uthamapalayam	Sugarcane, Cotton	*Tectona grandis, Ceiba pentandra, Cocos nucifera*
	Periyakulam	Rice, Sugarcane	*Tectona grandis, Azadirachta indica, Ailanthus excelsa*
	Dindukal	Sugarcane	*Tectona grandis, Azadirachta indica*
	Nilakkottai	Banana, Jasamina, Vegetable	*Azadirachta indica, Ailanthus excelsa*
	Vedasadur	Jasamine, Tapioca, Banana	*Azadirachta indica, Casuarina equisetifolia*

Zone	Locality	Intercrops	Tree spp.
Western Zone	Vedasadur	Banana, Rice	*Tectona grandis*
	Natham	Cowpea	*Azadirachta indica, Cocos nucifera*
	Natham	Banana	Ailanthus excelsa, *Azadirachta*
		Tapioco, Banana	*indica*
		Tapioco, Banana,	*Tectona grandis, Ailanthus excelsa*
		Turmeric, Tomato	*Tectona grandis, Ailanthus excelsa*
		Turmeric, Rice, Vegetables	
		Medicinal palnts	*Tectona grandis, Tamarindus indica*
		Banana, M. Kuinji, Onion	*Tectona grandis, Mangifera indica*
		Sorghum, Cowpea,	*Ailanthus excelsa, Cocos nucifera*
	Karur	Cowpea, Vegetables	*Azadirachta indica, Emblica officinalis*
	Karur	Sorghum, Banana, Cotton	*Azadirachta indica, Casuarina equisetifolia*
	Aravankurichi	Beetroot, Flowers, Banana	*Casuarina equisetifolia*
	Aravankurichi	Ground nut	*Casuarina equisetifolia*
	Khnarayapuramris	Fodder crops.	*Tectona grandis, Azadirachta indica, Borassus flabellifer*
	Khnarayapuramris	Fodder crops.	*Tectona grandis*
	Kulithalai	Cotton, Fodder crops	*Borassus flabellifer, Prosopis juliflora*
	Coimbatore	Fodder crops.	*Emblica officinalis, Tamarindus indica*
		Cotton, Ground nut	*Tectona grandis*

Zone	Locality	Intercrops	Tree spp.
Western Zone	Coimbatore	Vegetables, Cotton	*Tectona grandis, Azadirachta indica, Borassus flabellifer, Ailanthus excelsa*
	Pollachi	Turmeric ,Fodder crops, Vegetables, Pulses Ground nut	*Tectona grandis, Azadirachta indica, Tamarindus indica, Simaruba glauca*
	Udumalaipet	Cotton	*Simaruba glauca*
	Udumalaipet	Sapota, Nelli	*Emblica officinalis, Casuarina equisetifolia*
	Udumalaipet	Cotton, Vegetables	*Tectona grandis Tamarindus indica Borassus flabellifer*
High RF Zone	Kanyakumari	Home garden	*Pongamia pinnata, Delonix regia*
	Nagarkoil	Vegetables	*Eucaliptus tereticornis, Artocarpus heterophyllus*
Hill Zone	Chithery	Tea, Pepper	*Grevelia robusta*
	Chithery	Coffee, Cardamon	*Artocarpus heterophyllus, Erythrina indica*
Southern Zone	Madurai	Vegetables, Cotton	*Casuarina equisetifolia*
	Sivagangai	Pulses, Cotton, Ground nut	*Casuarina equisetifolia, Simaruba glauca*
	Manamadurai	Sorghum, Vegetables	*Emblica officinalis*
	Ramanathapuram	Sorghum, Flowers, Vegetables	*Tamarindus indica*

Zone	Locality	Intercrops	Tree spp.
Southern Zone	Kamuki	Sorghum, Cotton, Rice	*Casuarina equisetifolia*
	Viruthunagar	Ground nut, Cotton	*Casuarina equisetifolia)*
	Sivagasi	Fodder crops.	*Tectona grandis, Azadirachta indica , Tamarindus indica*
	Tuticorin	Fodder crops	*Tamarindus indica, Casuarina equisetifolia*
	Kovilpatty	Cotton, Fodder crops.	*Borassus flabellifer Prosopis juliflora*
	Thirunelveli	Fodder crops.	*Tamarindus indica*
	Nanguneri	Cotton, Ground nut Fodder crops	*Tectona grandis, Tamarindus indica*

DISCUSSION

In the above section a brief description about the various study locations and the agroclimatic zones they fall under have been given. The results for the above mentioned sections have been obtained from field observations (non-participatory method). In the subsequent sections results obtained from personal interviews with the farmers have been tabulated.

➢ Profile of Natural Resources:

The survey conducted had a holistic approach. It not only looked into the agroforesty systems practised in the various districts, it also involved general analysis of the various study sites. The analyses made have been further tabulated.

It portrays the description of the lands which were surveyed. Out of the 600 farmers interviewed 400 of them mainly depend on irrigation systems such as open well, bore wells, and canals to irrigate their field. 85 of the farmers mainly depend on rains, and the remaining 115 depend on both the systems.

TABLE 8. DESCRIPTION OF THE LANDS:DISCUSSION

SL.NO.	DESCRIPTION OF THE LANDS			TOTAL
	IRRIGATION LAND	RAINFED LAND	WELL IRRIGATION & RAINFED LAND	
1.	400	85	115	600

Table 7, describes the sufficiency of water in each of the study sites. Out of the 600 farmers interviewd, 289 of them were found to be sufficient in water, whereas the remaining 311 farmers did face some amount of difficulty due to shortage of water.

TABLE 9. SUFFICIENCY OF WATER

SL.NO.	SUFFICIENCY OF WATER		TOTAL
	YES	NO	
1.	289	311	600

During the survey it was found that, none of the farmers had to bore deep wells. All of them were able to access ground water within 10 to 40 meters.

TABLE 10. DEPTH OF WATER TABLE

SL.NO.	DEPTH OF WATER TABLE (in meters)	No. of FARMERS	TOTAL
1.	10 – 20	110	600
2.	20 – 30	341	
3.	30 – 40	149	

Most of the farmers (about 441) in all the study sites found ground water to be very reliable for agricultural practices. Table 11

TABLE 11 SAFE YIELD OF GROUND WATER

SL.NO.	SAFE YIELD OF GROUND WATER		TOTAL
	YES	NO	
1.	441	159	600

Out of the 600 farmers interviewed, it was found that, most did have fears of drought or extreme water shortage crisis.

TABLE 12. DROUGHT HAZARD

SL.NO.	DROUGHT HAZARD		TOTAL
	YES	NO	
1.	392	208	600

- **Profile of Agroforestry Systems:**

Out of the 600 farmers interviewed within a span of 12 months, in most of the farms (i.e. 390) intercropping was found to be the most followed practice.

TABLE 13. SYSTEM INTEGRATED WITH AGROFORESTRY:

SL.NO.	SYSTEM INTEGRATED WITH AGROFORESTRY			TOTAL
	INTERCROPPING	BOUNDARY	SIVICULTIVATION	
1.	390	181	29	600

In almost 357 farms the distribution of tree species were found to be very orderly. The mode of distribution was normally linear. Table 14

TABLE 14 DISTRIBUTION OF TREE SPECIES ON FARM LAND

SL.NO.	DISTRIBUTION OF TREE SPECIES ON FARM LAND			TOTAL
	LINEAR	RANDOM	ALONG THE BOUNDARY	
1.	357	207	36	600

One aspect of the study was to focus on the amount farmers needed to invest in agroforestry, and how much was the pay off. Such details are given in the following tables. Most of the farmers (i.e. about 358) had no necessity of investing in this system. But unless there is some investment, there would be lower benefit. Benefit not in the sense of cash, but in other terms.

TABLE 15. MONEY INVESTED IN AGROFORESTRY

SL.NO.	INVESTMENT ON TREES(PER YEAR)	No. of FARMERS	TOTAL
1.	100 – 1000	40	600
2.	1000 – 2000	50	
3.	2000 – 3000	45	
4.	3000 - 4000	43	
5.	4000 – 5000	5	
6.	5000 – 6000	33	
7.	6000 – 7000	9	
8.	> 8000	17	
	NO INVESTMENT	358	

TABLE 16. INCOME GENERATED FROM TREES

SL.NO.	INCOME GENERATED FROM TREES (PER YAER)	No. of FARMERS	TOTAL
1.	100 - 1000	73	600
2.	1000 - 2000	96	
3.	2000 – 3000	64	
4.	3000 - 4000	39	
5.	4000 - 5000	8	
6.	5000 - 6000	19	
7.	6000 - 7000	10	
8.	7000 – 8000	5	
9.	> 9000	24	
NO INCOME		**289**	

During the survey conducted, it was found that, most of the farmers preferred direct sales of their agro products. Table 15.

TABLE 17. AGROFORESTRY PRODUCT WATCH

SL.NO.	SALE OF PRODUCTS		TOTAL
	DIRECT SALE	THROUGH MIDDLEMEN	
1.	455	145	600

It was interesting to note that agroforestry systems were practised traditionally in most of the study sites. Hence one can conclude that agroforestry is not a new concept or a foreign idea.

TABLE 18. ORIGIN OF THE IDEA

SL.NO.	ORIGIN OF IDEA		TOTAL
	TRADITIONAL	TRAINING	
1.	549	51	600

TABLE 19. SUPPORT / TRAINNING RECEIVED FROM AGENCIES

SL.NO.	SUPPORT / TRAINING RECEIVED FROM AGENCIES		TOTAL
	YES	NO	
1.	55	545	600

TABLE 20 ECONOMIC USES OF FORESTRY TREES IN AGRO FORESTRY SYSTEMS AS FODDER, MANURE AND ORNAMENTAL

TREES FOR FODDER	TREES USED AS GREEN MANURE	TREES / SHRUBS FOR ORNAMENTAL PURPOSE
Acacia nilotica	*Leucaena glauca*	Nerium (*Nerium odorum*)
Albizia lebbeck	Neem (*Azadartica indica*	Hibiscus
Anacardium occidentale	)Nelli (Phyllanthus emblica)	(Hibiscus rosasinensis)
Anogeissus sp	Casuarina	*Peltophorum ferafineum*
Artocarpus hirsutus	(Casuraina equstifolium)	Poovarasamaram
Bauhinia racemosa	Ecalyptus	(*Thespesia populnea*)
Bambusa bambos	(Eucalyptus Globulus)	Punnamaram-
Musa paradisica	Vaathamaram	Caloplyllum inophyllum
Cacao	Punnamaram	Ashoka maram

TREES FOR FODDER	**TREES USED AS GREEN MANURE**	**TREES / SHRUBS FOR ORNAMENTAL PURPOSE**
Casuarina equistifolia	***(Calophyllum inophyllum)***	(*Saraca indica*)
Ceiba pentandra	Pongamia (Pongamia pinnata)	*Delonix regia*
Citrus spp	Thuringi	Cassia fistula
Elaeis guinensis	Udhaya	
Eucalyptus globus	Vathamaram	
Ficus exasperata	Punna maran	
Gauva (Psidium guajava)	Poovarasu	
Emblica officinalis	(Chloroxylon swietenia)	
Leucaena leucocephala (glauca)	Tamarindus (Tamarindus indica)	
Mangifera indica	*Lannea coromandelica*	
Coconut (Cocos nucifera)		
Azadirachta indica		
Murunga (Moringa Oleifera)		
Musa sapientum		
Pala (*Artocarpus integrifolius/ heterophyllus)*		
Piliostigma thonningii		
Pithacelobium dulce		
Sitha (Annona Squamosa)		
Spondias mangifera		

TREES FOR FODDER	TREES USED AS GREEN MANURE	TREES / SHRUBS FOR ORNAMENTAL PURPOSE
Tamarindus (Tamarindus indica)		
Odhayamaram		
Vathamaram		
Albizia Lebback (Vagai)		
Vepala		

Table 21 Economic Uses of Forestry Trees in Agro Forestry Systems in Industries, Medicinal and Timber

TREES FOR INDUSTRIES	TREES FOR MEDICINAL PURPOSES	TREES FOR TIMBER
Alamaram	Alamaram Arasamaram	Acacia nilotica indica
Accasia sp	Athimaram	Acacia tortilis
Porusu	Eucalyptus	Accasia auriculformis
Casuarina,	Gauva	Acasia sp
Coconut	Nelli	Albizia lebbeck
EucalyptusJ	Murungamaram	Alagium
ackfruit	Karuveppila	Ettimaram (Nux-vomica)
Guava	Vathamaram	Anacardium sp
Mango	Neem	Anogeissus latifolia
Moongil	Nux-Vomica	***Areca catechu***
Neem	Papaya	Artocarpus hirsutus

TREES FOR INDUSTRIES	TREES FOR MEDICINAL PURPOSES	TREES FOR TIMBER
Palm	Palm	Artocarpus occidentale
Pakku	Pakku	Bambusa
Punnamaram	Punnamaram	Bombax spp
Pithecelobium	Velikathan, Alingimaram(Alangium)	Porusu
Poovarasamam	Thurungi (Albizia anova)	Casuarina
Red sandal	Sitha	Coconut
Tamarindus	Sapota	Ceiba sp
Teak	Tamarindus	Dalbergia latifolia
Thikuchimaram	Vagai	Diospyros melanoxylon
Vagaimaram	Vathamaram	Elanthai
Vepalamaram		Ettimaram
Udhayamaram		Eucalyptus
		Ficus sp
		Gymnema sylvestris
		Gauva
		Leucaena
		Mango
		Moongil
		NeemNux-Vomica
		Palmyrah

TREES FOR INDUSTRIES	TREES FOR MEDICINAL PURPOSES	TREES FOR TIMBER
		Pakku
		Poovarasu
		Pongamia
		Pethecelobium
		Punnamaram
		Prosopis juliflora
		Pterocarpus marsupium
		Red sandal
		Silver oak
		Sitha
		Tamarindus
		Tectona grandis
		Thuringi
		Ulmus spp
		Odhayamaram
		Velamaram
		Vathamaram
		Vepala
		Xylia xylocarpa

Table 22 The Agro Forestry Trees Used for Domestic purposes and Preferred species

TREES USED FOR DOMESTIC CONSUMPTION	PEOPLES PREFERRENCES
Papaya, Nelli	Acasia sp
Athi	Alingi
Banana	Areca catechu
Cashew	Bamboo
Ceiba pentandra	Banana
Coconut	Porusu
Gauva	Eucalyptus
Mango	Casuarina
Murangai	Coconut
Curry leaves	Gauva
Elantha,	Sapota
Lemon	Mango
Jackfruit	Teak
Tamarind	Tamarind
Velampazham	Palmyrah
Sitha	Jackfruit
Naval	Neem
Sapota	Curry leaves
Pakku	Lemon
Pithecelobium	Murungai
	Nelli
	Pakku
	Pithecelobium
	Red sandal
	Vepala
	Vagai
	Odhamayam
	Thikuchi maram

It was generally noted that in almost all the agroclimatic zones, trees like; Coconut *(Cocus nucifera*), Tamarind (*Tamarindus indica*), Manila Tamarind (Koduka puli / *Pithacelopium dulce*), Mango (Mangai / *Mangifera indica*), Neem (*Azaradatica indica*), Teak (*Tectona grandis*), Palm (), Vagai (*Albizia lebbeck*), Pooarasu (*Chloroxylon swietenia*), Pinnamaram (*Calophyllum inophyllum*), Udhayamaram (), *Acacia nilotica*, *Artocarpus hirsutus*, Eucalyptus (*Eucalyptus globules*), Casurina (*Casurina equisetifolia)* and fruit trees like; Gauva (*Psidium guajava*), Custard Apple (Sitha / *Annona Squamosa*), Drumstick (Murungai / *Moringa oleifera*), Gooseberry (*Phylantus emblica* / Nelli), Jackfruit (Pala / *Artocarpus integrifolia*), were commonly found tree species.

During the interview, most of the farmers (about 54.67% i.e. 328) felt that most number of tree species would take 20 to 30 months for it to develop from a sapling. About 1.33% (i.e. 8) of the farmers said that it depended on the type of tree planted, and on the environmental conditions.

TABLE 23 LENGTH OF GROWING SEASON – FOR PREDOMINANT TREES

SL.NO.	LENGTH OF GROWING SEASON FOR PREDOMINANT TREES (in months)	No. of FARMERS	TOTAL
1.	10 – 20	183	600
2.	20 – 30	328	
3.	30 - 40	82	
4.	**DEPENDS**	8	

Most of the farmers (about 40.833% i.e. 245) did not feel the need to have fruit trees in their farms, since fruit trees would need a lot of care and maintenance. Most of them preferred hard wood trees. Those who had fruit trees: about 19.5% (i.e. 117) of the farmers had six to ten fruit trees in their farmlands, and only 3.833% (i.e. 23) of the farmers had more than 50 fruit bearing trees on their farms.

TABLE 24 NO. of FRUIT BEARING TREES ON FARMLANDS

SL.NO.	No. of FRUIT BEARING TREES	No. of FARMS	TOTAL
1.	1 - 5	83	600
2.	6 - 10	117	
3.	11 - 15	25	
4.	16 - 20	19	
5.	21 - 25	37	
6.	26 - 30	15	
7.	31 - 35	8	
8.	36 - 40	9	
9.	41 - 45	13	
10.	46 - 50	6	
11.	> 51	23	
12.	**NO FRUIT TREES**	245	

- **Socio-economic and Livelihood Profile:**

The focus of the survey not only on integrated agroforestry systems, but also on livelihood and socio-economic profiles of the farmers interviewed. Socio-economic profile includes family size, and literacy. Tables (), and (). Livelihood profile includes occupation.

During the survey it was noted that about 53% (i.e. 318) of the farmers questioned had five to seven family members in one family. 38.33% (i.e. 203) of the farmers had two to four family members in one family. About 13.167% (i.e. 79) of the farmers had more than 8 members in one family alone.

TABLE (25) FAMILY SIZE

SL.NO.	FAMILY SIZE	No. of FAMILIES	TOTAL
1.	2 - 4	203	600
2.	5 - 7	318	
3.	8 - 10	77	
4.	> 10	2	

About 60.67% (i.e. 364) of farmers were functionally literate (i.e. they knew to sign their name). Only about 26.5% (i.e. 159) of farmers questioned had the privilege of completing primary education. About 12.833% of farmers had completed higher education, or had undergone vocational training.

TABLE 26 LITERACY

SL.NO.	LITERACY				TOTAL
	FUNCTIONAL	PRIMARY EDUCATION	HIGHER EDUCATION	VOCATIONAL / PROFFESIONAL	
1.	364	159	64	13	600

Most of the farmers interviewed (62.166% i.e. 373) considered their primary occupation to be farming.

TABLE 27 PRIMARY OCCUPATION

SL.NO.	PRIMARY OCCUPATION			TOTAL
	FARMER	OTHER EMPLOYMENT	PRIVATE SERVICE	
1.	373	173	54	600

➢ Profile of Asset Ownership:

Only 3.5% (i.e. 21) of the farmers do not own land. About 32.333% (i.e. 194) of the farmers have six to ten acres. Most of the farmers fall in this category. Very few, about 2.833% (i.e. 17) of the farmers have more than 51 acres of land.

TABLE 28 ASSET OWNERSHIP

SL.NO.	LAND OWNED (ACRES)	No. of FARMERS	TOTAL
1.	1 - 5	169	600
2.	6 - 10	194	
3.	11 - 15	54	
4.	16 - 20	26	
5.	21 - 25	39	
6.	26 - 30	36	
7.	31 - 35	14	
8.	36 - 40	11	
9.	41 - 45	13	
10.	46 - 50	6	
11.	> 51	17	
12.	**NO LAND OWNED**	21	

5.0.CONCLUSION

Farmers adopt agroforestry practices for two reasons. They want to increase their economic stability and they want to improve the management of natural resources under their care. Agroforestry systems, especially for tropical climates, have not traditionally received much attention from either the agricultural or the forestry research communities. Nevertheless, implementing designs using trees and bushes to enhance crop or livestock production, waste management, and natural resource protection is a step toward a permanent, stable agriculture (*Alice Beetz, 2002*). Each requires a careful initial design adapted to the site and the farm operation, continuous observation, and a commitment to a long timeline. Questions of sustainability are treated from individual farm, community, and societal perspectives.

Present classification schemes confuse agroforestry practices, where trees are intimately associated with agricultural components at a field scale, with the whole farm and forest systems of which they form a part. In fact, it is common for farming systems to involve the integration of several reasonably discrete agroforestry practices, on different types of land. The purpose of a general classification is to identify different types of agroforestry and to group those that are similar, thereby facilitating communication and the organized storage of information.

A new scheme should be proposed to use the 'practice' rather than the 'system' as the unit of classification. This allows an efficient grouping of practices that have a similar underlying ecology and prospects for management. A two stage definition of agroforestry is proposed (*Fergus L. Sinclair*, 1999) that distinguishes an interdisciplinary approach to land use from a set of integrated land use practices. Four levels of organization are recognized through analysis of the role of trees in agricultural landscapes:

- the land use system,
- categories of land use within systems,
- discrete groups of components (trees, crops, and animals) managed together, and
- Functionally connected groups of such discrete practices in time and space.

Classification of major types of agroforestry practice proceeds primarily according to the components involved and the predominant usage of land. USDA (2006) explains that agroforestry techniques will help increase the diversity and abundance of crop. Secondly these techniques can be incorporated easily into many existing farming practices. Importantly, ways to preserve diversity of livelihood systems in economic analyses are incorporated in the agroforestry practices (*P.E. Hildebrand*, 2001). Previalance of a variety of traditional Agroforestry systems in India offers opportunity worth reconsidering livelihood improvement, biodiversity conservation, soil fertility enhancement and poverty reduction (Panday, 2007)

The project was an opportunity to educate landowners and community residents about the value of Agroforestry habitat for the ecosystem and for the bottom line livelihood improvement, climatic change mitigation and sustainable development in research, policy and practice will have to progress towards

1. Effective communication with people in order to enhance the agroforestry practices with primary to multifunctional values,

2. Maintenance of traditional Agroforestry system and strategic creation of new systems

3. Enhancing the size and diversity of Agroforestry systems by selectively growing trees more useful for more livelihood improvement

4. Designing a context specific cultural and farming system to optimize food production.

5. Maintain continuous cycle of regeneration harvest regeneration as well as looking at the wood non emitting uses such as wood carving and durable furniture

6. Participatory domestication of useful fruit tree species currently growing in the wilderness to provide more option for the livelihood improvement

7. Strengthening the markets for non timber forest product

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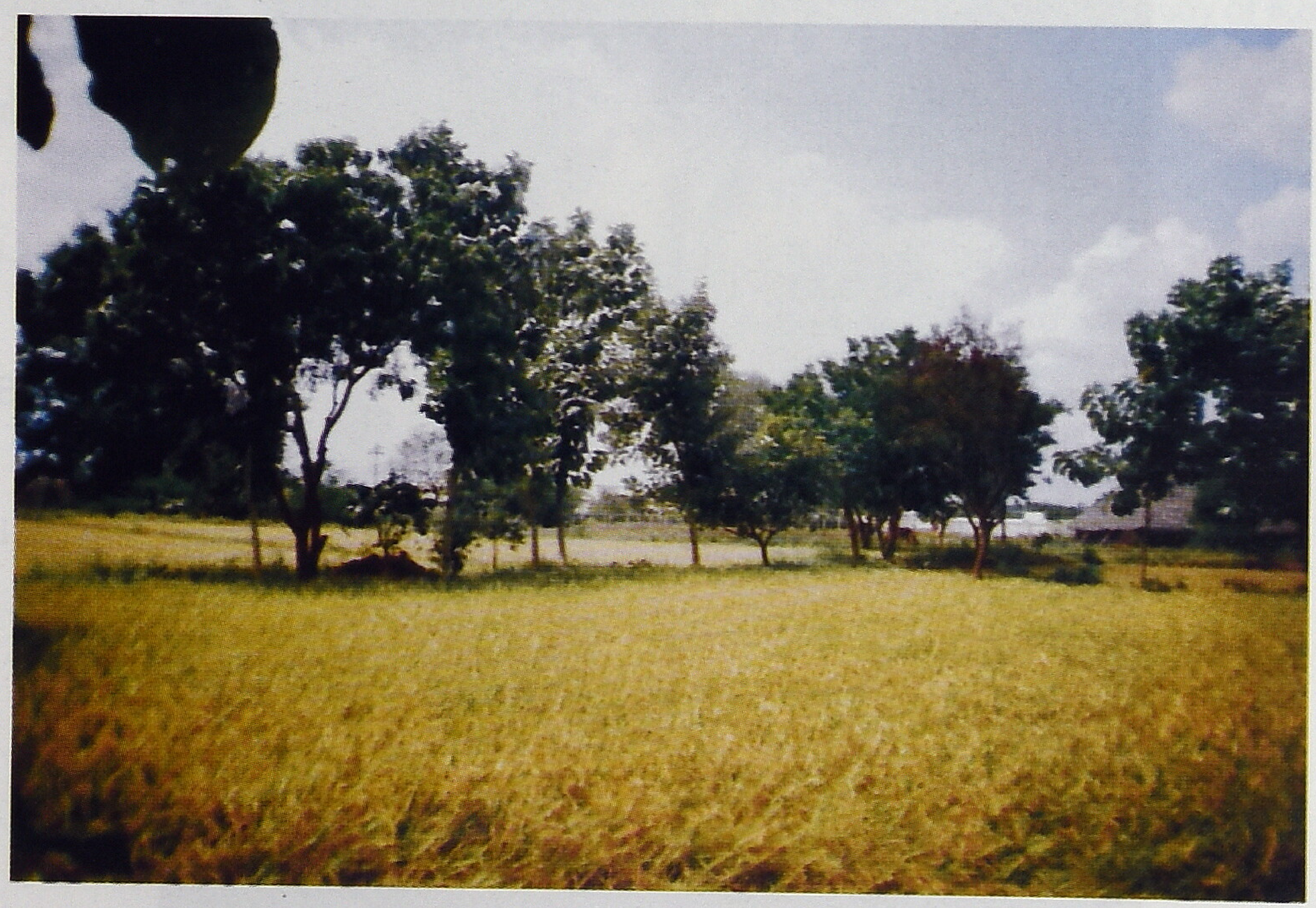
Plate : 1 Traditional Agro Forestry Systems in North Western Zone

Sorghum with *Acacia nilotica* based Agro Forestry System in Dharmapuri area

Banana with Coconut based Silviculture System in Harur area

Plate : 2 Traditional Agro Forestry Systems in Western Zone

A Farmer Interviewed for Collecting Agro Forestry Practices in Western Zone



Oryza with Neem and Teak based Silvipasture System in Madurai area

Plate : 3 Traditional Agro Forestry Systems in Western Zone

Oryza with *Ficus benghalensis* tree which is untouched for cultural reason in Pollachi area

Sorghum with Coconut Silvipasture System in Coimbatore area

Plate : 4 Traditional Agro Forestry Systems in Southern Zone

Oryza with *Acacia nilotica* based Silviculture System in Ramanathapuram area

Chloroxylon swetienia sylviculture with motchai-bean (seed type) cultivation in Orathanadu, Thanjavur district

Annexure 1

DISTRICT WISE SURVEY OF AGROFORESTRY TREE SPECIES UTILIZED AND GROWN IN ORDER OF DEMAND IN TAMILNADU

DATA AT THE LEVEL OF THE HABITATION

Date :

Name of the Interviewer :

Agroclimatic Zone :

Name of the Study Site :

Distance from the nearest town / city :

Altitude :

Predominant Soil Type :

Predominant Vegetation Type :

RESPONDENTS:

1. Presence of Water bodies / water source with description
2. Predominant occupation / livelihood
3. Total no. of Farming Households
4. Total no. of Farmers
5. Total Land Holding in the study site
6. Local classification of Agricultural Lands
7. Extent of land under each category
8. Number of Big Farmers

9. Number of Small Farmers
10. Number of Marginal Farmers
11. Number of Landless Farmers
12. Number of Agricultural Seasons
13. Major Agricultural Crops
14. Minor Agricultural Crops
15. Cropping Patterns
16. Description of the Agroforestry Systems in the study site
17. Most Dominant planted tree species
18. Most Preferred tree species and reason
19. Least preferred tree species and reason
20. Markets for the agroforestry species.

DATA AT THE INDIVIDUAL LEVEL:

Date :

Name of the Farmer :

Village :

District :

Agroclimatic Zone :

1. No. of family members
2. No. of literates in the family
3. Primary Occupation
4. No. of acres owned by the farmer
5. No. of acres leased by the farmer
6. Description of the land
7. Number of Fruit bearing trees
8. Trees for Fodder
9. Trees for Green manure
10. Trees for Ornamental purpose
11. Trees for Industries
12. Trees for Medicinal purposes
13. Trees for Food

14. Trees in the field left untouched for Cultural reasons

15. Trees in the field used for Timber

16. Income generated from trees

17. Miscellaneous usage of trees as identified by the respondent

18. Species decided but not available

19. System integrated with agroforestry

20. Origin of the Idea

21. Trees meant for Domestic consumption

22. Have you the necessary physical support facilities?

23. Where do you sell the products obtained from the trees, and how do you transport the material?

24. Cost incurred for transportation

25. To who are the products sold?

26. What are the major items sold (list) and provide details of price in rupees:

27. Most preferred tree species

28. Least preferred tree species

29. Local land customary rights

30. Legal and customary rights

31. Safe yield of ground water

32. Depth below surface of useful ground water

33. Sufficiency of water

34. Irrigation need / Drought Hazard

35. Length of growing season for predominant trees

36. How much money have you invested in this operation?

37. Distribution of tree species in farmers land

38. Support / Training received from agencies

ANEXTURE 2. LENGTH OF GROWING SEASON – FOR PREDOMINANT TREES

SL.NO.	LENGTH OF GROWING SEASON – FORPREDOMINANT TREES	No. of FARMERS	TOTAL
1.	10 – 20	183	600
2.	20 – 30	328	
3.	30 - 40	82	
4.	DEPENDS	8	

ANEXTURE 3. FRUIT BEARING TREES ON FARMLANDS

SL.NO.	No. of FRUIT BEARING TREES	No. of FARMERS	TOTAL
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6.	26 - 30	15	
7.	31 - 35	8	
8.	36 - 40	9	
9.	41 - 45	13	
10.	46 - 50	6	
11.	> 51	23	
12.	NO FRUIT TREES	245	

Fig. 1 Description of the Lands

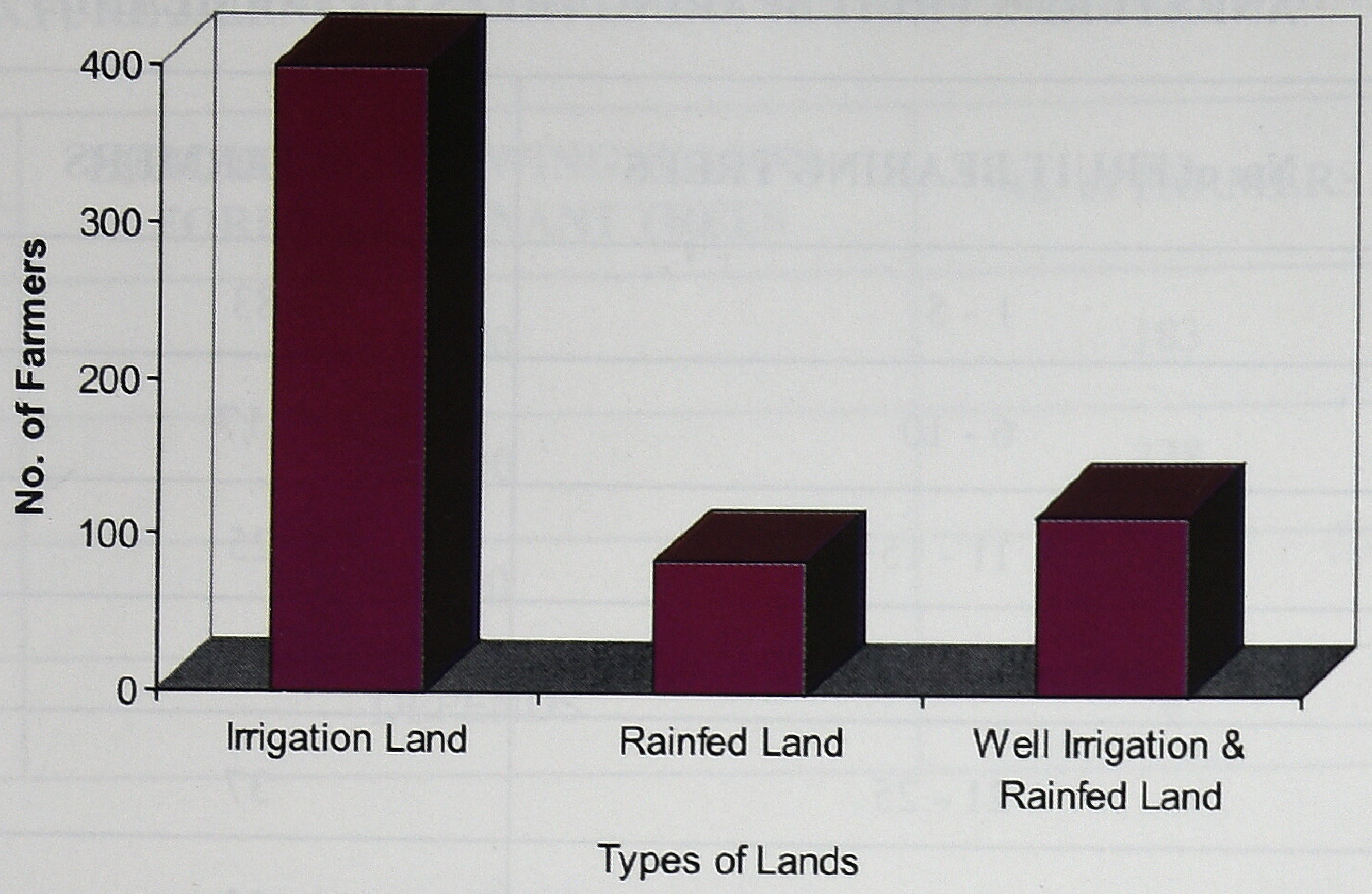

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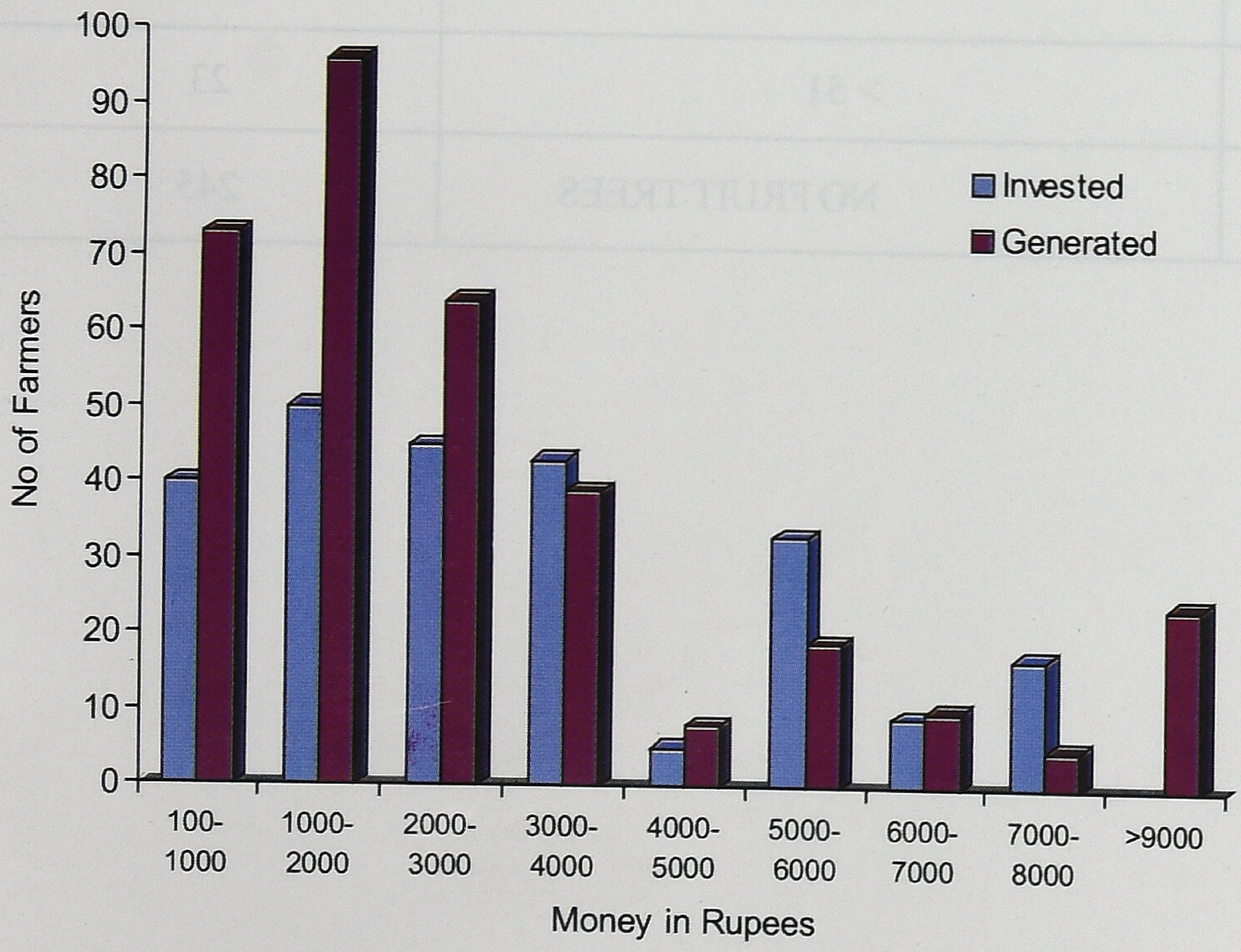
Fig 2 Money Invested & Generated in Agroforestry



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